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MEDICAL STUDY

ON THE

MINERAL WATERS

OF

VICHY

COMPARATIVE ANALYSIS OF THE WORKS

PUBLISHED ON THOSE WATERS, BY

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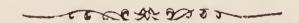
MEDICAL STUDY

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MINERAL WATERS

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VICHY



I

The natural springs of Vichy, which are the property of the State, are nine in number: they are:

The Grande Grille;

The Grand Puits Carré:

The Petit Puits Carré or Puits Chomel;

The Gros Boulet or Fontaine de l'Hôpital;

The Petit Boulet or Fontaine des Acacias;

The Lucas spring;

The Celestins or Rocher spring;

The Celestins de la Grotte;

The New Celestins (discovered in 1870);

By boring has been obtained the springs:

Brosson;

Hauterive;

Mesdames.

H

The Vichy springs, as well as the gushing waters of Hauterive and Mesdames, have a common origin; they all issue from the fresh water calcareous deposit which forms the bottom of the valley of the Allier, but they evidently proceed from the primordial strata, and they probably form, at the point of contact of that soil and the lacustrian deposit, a sheet of greater or lesser extent; they next reach the surface by traversing the layers of the tertiary soil, either by natural fissures or by orifices which may be opened in it artificially.

wherever borings have been made » says M. Dufrénois, Inspector General of Mines, in a report addressed in 1852 to the Minister of Agriculture and Commerce, on the regime of the Vichy waters « within a radius of about 10 kilometres around the springs of Vichy, there has been found alkaline gaseous waters analogous to those of Vichy. There is consequently in that basin, a considerable quantity of mineral water. It has been ascertained by borings that those different springs all issue from the alluvium which covers the

valley of the Allier; they have been stopped at a laye of reddish clay which appears to exist everywhere at the same level, dividing the alluvium soil into two parts. The borer, after piercing that layer, has in fact invariably brought up sand similar to that of the upper portion. The alluvium soil situated below the layer of clay may therefore be considered as forming a sort of sponge, which receives the mineral waters of the ascending shaft, and conveys them to the surface, either by natural artesian wells, like the Puits-Carré, or by tubular openings made through the solid mass by boring.

- "That disposition of the mineral waters of Vichy differs essentially from that of the mineral waters in mountainous districts, such as the Alps, the Pyrenees, Mont-Dore and the Vosges. These latter issue directly from the crystalline rocks; it is consequently easy, by subterranean galleries, generally of little extent, to reach their source, to enclose the different channels with concrete, and thus unite and collect them.
- "There is no doubt that the waters of Vichy present an analagous disposition, that they are brought from the depths where they have their source, by a gallery traversing the cristalline strata which rise above Vichy, but that gallery, instead of debouching on the slopes of the neighbouring mountains, has its orifice at the bottom of the valley; it sheds its waters in the alluvium soil which covers it, and of which the

the thickness, according to certain borings, is more than 150 metres. The system of following up the springs and encasing them, which has succeeded so well in other localities, cannot therefore be practised at Vichy.

"The want of cohesion in the elements of the alluvium soil also requires that works about the springs should only be undertaken with the greatest circumspection; too sudden movements in the part of the gallery which traverses that soil, might loosen the sides of it, and block it up with its own debris. Moreover, the alluvium, consisting of grains of sand mixed with ochreous clay, is porous, and the water circulates through it easily in all directions....»

M. Bouquet, the author of the most complete analytical work existing on the Vichy waters, considers the Vichy springs as the real centre of that immense bed, from which is incessantly springing up hot waters, holding in solution saline bodies which we shall presently enumerate, issuing from the porphyry or volcanic and basaltic rocks, and spreading into the lower strata of the tertiary soil, and then constituting by numerous channels, the hydrological basin of Vichy.

« There is no doubt, » he adds, « that those thermal waters have not there starting point below the lacustrian soil, but are really of geological formation, like the crystalline rocks to which they appear to be really subordinated; they derive scarcely anything from the upper layers of chalk or lime, but form in them, on

the contrary, a concrete body, thus isolating themselves by a tubular channel of a stony composition borrowed from their own substance. The fact is besides not the less worthy of remark that the waters, after having traversed the porphyry, bring to the light fifteen or twenty times more soda than potash, whilst in the composition of the crystalline rocks, the weight of the latter is at least equal to a quarter of that of the soda.»

The quantity of saline substances drawn from the interior of the earth by the mineral waters of the basin of Vichy is beyond imagination. It is estimated by M. Bouquet at 5,102 kilogrammes every twenty four hours, or 1,861,230 kilos (1,861 tons) a year. The neighbouring rivers, and especially the Allier, receive almost the whole of those saline substances; alone, the carbonic acid arising from the decomposition of the bicarbonates, or dissolved in a free state by the waters, is absorbed by the atmosphere, and spreading abroad serves to enrich vegetation.

« The geological origin of those mineral waters explains sufficiently the remarkable permanence of their chemical composition; that permanence cannot however be eternal; being intimately bound up in the existence of the phenomena which are the first causes of it, it must vary with their intensity. We must therefore expect to see, in the future, the temperature and mineralization of the Vichy springs slowly decrease; but without professing to foresee the period

at which they will cease to spring forth, or will yield only soft water, we may safely affirm that such a change will require a series of ages comparable to the geological periods, and that consequently thousands of years will elapse before serious modifications, or even an appreciable change, will be manifested in the chemical composition or temperature of these mineral waters.»

M Bouquet has made also an interesting study on the deposits which the Vichy mineral waters leave in the movable parts of the soil in traversing them, in the pipes by which they are conducted, and of which an enormous specimen may be seen before our eyes above the Célestins spring.

« If the release of the gas is rapid, » he says, «the deposit is more or less incoherent; it is on the contrary hard and crystalline when the release of the gas is impeded by some obstacle. To this latter circumstance very probably must be attributed the origin of the deposits of which the existence has been often remarked around the springs. One of them has formed around the Puits-Carré a quite recent layer of arragonitic travertine which in no wise differs from that of the Célestins; a second block, quite similar, serves as the step of a staircase in the establishment of the Hôpital baths; lastly, the excavations executed during the last few years around the mineral springs have brought to light large masses of calcareous deposit; amorphous and bituminous at the Lucas spring,

crystalline at the Grande-Grille, and each containing a considerable proportion of clay and sand, evidently derived from the surrounding earth.»

Plane concretions of any considerable extent are invariably horizontal; the Célestins rock is however remarkable for its vertical position. «It is however impossible », remarks Sir Roderick Murchison, one of the most learned geologists in Europe « even in the absence of any traces of rupture or dislocation, to imagine that those vertical arragonitic masses can have been thus deposited since the present geographical constitution of the country became fixed and determined, for their summit is as elevated as the soil in any part of the neighbourhood can be. Even had the waters been raised to such an elevation by a sort of natural fountain, nature herself would have been powerless to range their deposit in that vertical form for a distance of 250 yards (1). »

M. Bouquet thinks that being originally deposited, like the others, in a loose soil, the Célestins rock, left isolated by the erosive action of the waters during the formation of the valley, and being no longer supported, must have toppled over and been broken in falling.

⁽¹⁾ Sir Roderick Impey Murchison, on the slatey rocks of the Sichon and on the origin of the mineral springs of Vichy (From the Quarterly Journal of the Geological Society of London, 1851, vol. VII.

III

The waters of Vichy are all extremely alkaline and very limpid; they derive their flavour of soap-suds, which is not unpleasant, from the carbonic acid gas contained in them in a large quantity; in rising to the surface of certain springs, that gas produces an effervescence in the water.

The waters of the Célestins and Hauterive springs have a sharp and acid taste. The Acacias and Lucas springs, like the Puits-Chomel, emit a slight odour of hydro-sulphuric acid, which, very volatile and inappreciable in the analysis, disappears at a very short distance, even from the point where the waters issue from the earth.

IV

Formerly analysed by Raulin, Desbrest, Geoffroy and Mossier, and during the last thirty years by MM. Longchamp, Berthier and Puvis, and O. Henry, the Vichy springs have at all periods presented an almost identical composition.

Since then M. O. Henry, by order of the Government, has analysed the Grande-Grille, Brosson, Mesdames, and Hauterive springs; and still more recently M. Bouquet, as already mentioned, has published the most complete analytical work on the Vichy waters we possess.

M. Longchamp found each litre of water to contain the following substances:

SUBSTANCES				SPRINGS			
CONTAINED IN THE WATERS	GRANDE	PETIT PUITS CARRÉ	G ^d PUITS CARRÉ	HOPITAL	ACACIAS	LUCAS	CÉLESTINS
Carbonic acid	Litres 0,475	Litres 0,499	Litres 0.534	Litres 0.491	Litres 0.649	Litres 0.540	Litres 0.562
Carbonate of soda of lime of magnesia Chloride of sodium. Sulphate of soda. Silica.	Grammes 4.9814 0.3498 0.0849 0.6700 0.4725 0.0029 0.0736	Grammes 4.9814 0.3488 0.0852 0.6700 0.4725 0.0031 0.0721	Grammes 4.9314 0.3429 0.0867 0.5700 0.4725 0.0066 0.0726	Grammes 5.0513 0.5223 0.0952 0.5426 0.4202 0.0070 0.0478	Grammes 5.0513 0.5668 0.0972 0.5426 0.4202 0.0170 0.0510	Grammes 5.0863 0.5005 0.0970 0.5463 0.3933 0.0029 0.0415	Grammes 5.3240 0.6103 0.0725 0.5790 0.2754 0.0059 0.1131

The results of the analysis by M. O. Henry were as follows, per litre of water:

HAUTERIVE First Brosson	litres 0.511 grammes 6.240 signs 0.140 0.140 0.140 0.140 0.005 0.005 0.005 0.410 0.510 sensible 2 0.050 0.050 0.050 0.050
MESDAMES	litres 0.591 grammes 4.835 0.052 0.052 0.075 traces id. 0.017 traces 0.200 0.160 0.344 sensible signs signs 6.282
BROSSON (NEW)	grammess 4.840 signs 0.094 0.057 traces id. 0.001 » 0.410 0.410 0.500 0.003 sensible ? 0.340 0.230 signs 6.482
GRANDE	litres 5.231 grammes 4.900 signs 0.107 0.065 traces id. 0.001 " " 0.469 0.020 0.020 0.038 0.004 sensible ? 0.400 0.200 signs
SUBSTANCES	Anhydrous bicarbonates of soda. Anhydrous bicarbonates of soda. of lime. of magnesia Oxyde of iron (sesquioxyde) — of manganese. Anhydrous sulphates of lime. of magnesia. of magnesia. of potash. Alkaline iodide and bromide. Calcareous or aluminous phosphate. Silicate of soda. of alumine. of alumine. Arsenical principles.

Subjoined is the chemical composition per litre as fixed by M. Bouquet:

					120		-		range.	-	٠			-	-		
MESDYMES	1.908	4.016	0.189	0.425	0.003	0.604	0.026	traces	0.250	traces	0.003	traces	0.355	0.032	traces		7.715
HAUTERITE	2.183	4.687	0.189	0.501	0.003	0.432	0.017	traces	0.291	0.046	0.003	traces	0.534	0.071	traces	1	8.956
рако (виоззои)	1.555	4.857	0.292	0.213	0.005	0.614	0.004	traces	0.314	0.140	0.003	traces	0.550	0.055	traces		8.601
OÉLESTINS DE LA GROTTE	1.299	4.101	0.231	0.554	0.005	0.699	0.044	traces	0.314	traces	0.003	traces	0.550	0.055	traces		7.865
об коонек ов коонек	1.049	5.103	0.315	0.328	0.005	0.462	0.004	traces	0.291	0.091	0.003	traces	0.534	090.0	traces	1	8.244
HOPITAL	1.067	5.029	0.440	0.200	0.005	0.570	0.004	traces	0.291	0.046	0.005	traces	0.518	0.050	traces		8.222
SAOUL	0.751	5.004	0.282	0.275	0.002	0.545	0.004	traces	0.291	0.000	0.003	traces	0.518	0.050	traces		7.797
анльо-гич	0.876	4.893	0.378	0.335	0.003	0.421	0.004	traces	0.291	0.028	0.002	traces	0.534	0.068	traces		7.833
PUITS-CHOMEL	0.768	5.091	0.371	0.338	0.003	0.427	0.004	traces	0.291	0.070	0.003	traces	0.534	0.070	traces		7.959
GEVADE-CHILLE	0.908	4.883	0.352	0.303	0.003	0.434	0.004	traces	0.291	0.130	0.00	traces	0.534	0.070	traces		7.914
	Free Carbonic Acid	Bicarb. of Soda	Potash	Magnesia	• Strontia	Lime	• Protox. of Iron	Manganèse	Sulphate of Soda	Phosphate ,	Arseniate ,	Borate ,	Chloride of Sodium	Silica	Organic Bit. Matter		Totals

In this list of substances are some newly discovered, such as the alkaline iodides and bromides, lithia, strontian, silicate of soda, manganese, and an arsenical principle. Although in very small quantities those substances are certainly not without their action on the animal economy.

Besides the mineral principles, the Vichy waters contain a gelatinous and ropy substances (glairine), a real conferva, which is to be found in most mineral waters; it is especially seen in the Hospital spring, which it covers with a greenish scum. M. Vauquelin found that there was great analogy between its composition and that of albumen.

To complete the information contained in the above tables, it may be useful to give the opinion of the Academy of Medecine, on the composition of the different springs of the Celestins; that opinion, consigned in the minutes given annexed in extenso, was formed after the captage, or encasing of the new spring discovered in 1870.

- « Extract from the minutes of the Academy of « Medecine.
- « Sitting of March 12th 1872 under the Presidency « of M. Barth.
- « M. Mialhe, in the name of the committee on mi-« neral waters, read the report on the waters of « Vichy.

"The Celestins spring at Vichy, not yielding sufficient water for the consumption, the State decided
on making researches in the mass of the big rock
from which different springs flow. On the 29th May
1870, a blast gave passage to a jet of mineral water which filled up the pit sunk, and
overflowed the basin. The flow of this spring became by degrees regular and repeated measurements
proved that it yielded 22,500 litres every twenty
four hours. The temperature of the water at the
orifice is from 14 to 15 degrees centigrade (57 1/5
to 59 Fah.); the yield of the old spring has neither
increased nor diminished and does not exceed 200
it litres a day.

- w The Minister of Agriculture has requested the
 w Academy to make a comparative analysis of the
 w different samples of water in order to ascertain the
 w similitude or the difference which the springs may
 w present in their composition.
- w For that purpose the Academy has received fourw cases of water, labelled as follows:
 - « 1° Old Célestins spring;
 - « 2° Célestins spring (Grotte);
- « 3° Célestins spring (Griffon in the basement of « the grotto);
 - « 4° Célestins spring discovered 29th May 1870.
- « According to the certificate those waters were « drawn on the 24th November 1871.

« As what was required was to compare the diffe-

« rent springs above mentioned, the quantities of the

· essential substances contained in them were ascer-

« tained, no account being taken of the ingredients

« only found in minute proportions. The alkali was

« determined by a trial with the alkalimeter, and

« calculated in the state of carbonate of soda, after

" the earthy carbonates had been eliminated.

" The comparative results obtained by M. Bouis were the following:

			Nº. 1.	Nº 2.	N° 3.	Nº 4.
• Ir	isoluble	residue	5.120	5.060	5.020	5.200
« C	arbonat	e of lime	0.430	0.485	0.480	0.490
•	-	of magnesia	0.060	0.058	0.060	0.060
•		of soda	3.750	3.640	3.630	3.760
« Si	ulphate	of soda	0.295	0.300	0.280	0 304
· C	hloride	of sodium	0.534	0.529	0.540	0.530

It will be readily seen by an inspection of the
above table that the waters of the four springs are
identical, and that, consequently, the new Célestins
spring may be substituted for the old one for all
medical purposes.

Certified copy:

The perpetual Secretary,
J. BÉCLARD.

The two springs the richest in alkaline and terreous bicarbonates are those of the *Celestins* and *Hauterive*. The *Grande-Grille*, *Puits Chomel*, and *Grand-Puits* have an almost identical composition. The spring the

least charged with bicarbonate is the Mesdames, but as a compensation it contains a much larger proportion of furruginous principles which are found in the state of bicarbonate of protoxyde (ferreous bicarbonate). A great number of experiments made with the greatest care, on the composition of that spring, and repeated clinical results, have proved that the Mesdames spring is very ferruginous.

All those waters, in consequence of their cooling in contact with the air, deposit a certain quantity of their mineralizing principles. They 'produce concretions more or less abundant and the chemical characteristics of which are easily recognized. Those deposits often end by blocking up the channel and hindering the flow of the waters; at the *Celestins* they form a complete rock. In the basin of the *Mesdames* is deposited an ochreous sediment of a reddish colour.

The springs have different degrees of temperature, and observations made at different periods have shown in that respect notable variations. In general the most abundant springs are the hottest, and those which yield only a small thread of water are the coldest; thus the *Puits-Carré* and the *Grande-Grille*, which yield respectively 240,000 and 96,000 litres of liquid, have a temperature of 44 and 40 degrees centigrade and that of the *Grande-Grille* has risen 10 degrees since the works which have increased the volume of water ten fold. The *Celestins* spring which gives about 25,000 litres a day, is almost cold, and marks from 15 to 16 degrees; the *Mesdames*, spring of which the

daily yield is 20,000 litres has a temperature of 16 degrees, and lastly the *Hauterive* spring, which yields 30,000 litres, is of 14 degrees. It would seem that with all, their greater or lesser rapidity in arriving at the surface of the earth, causes a difference in the quantity of heat they have drawn from the common reservoir.

V

The celebrity and vogue the Vichy waters have enjoyed for centuries, are justified by the energy of their mineralizing principles, and by the efficacy of their medical properties.

Being easily absorbed and conveyed by the circulation into our organs, and all the tissues, they act, like most mineral waters, by producing more or less excitement, the immediate effect of which is to arouse the vitality of the tissues and the functions, and to cause, as Bordeu expressed it, a general winding up of the system. The result of that common action is that the most different maladies derive a salutary relief from the same mineral water.

But, to infer from those general effects that all mineral waters act in an identical manner, and that it is always by the mere stimulus to the functions of the economy that they modify the general morbid or local conditions to which they are opposed, would be to only examine that important question from a single

point of view, and to disregard the precious aid the modern works of chemists have given to physiology and therapeutics.

If it is certain that all mineral waters have properties in common, the fact is not less certain that each of them possesses a special action which depends on the nature of the chemical principles it holds in solution. In the cases in which alkalis are indicated, acids cannot render the same services; purgative elements cannot be substituded for tonics or astringents, any more than iron could be substituted for sulphur, etc.

Therefore the mineral waters in which alkalis predominate, whether ferruginous, sulphurous, or purgative, will each possess a mode of action proper to it, and it is a capital error to suppose that they may be substituded the one for the other, or be employed indiscriminately with equal success.

VI

It is not now possible to deny the influence of chemical agents on the animal economy; thanks to the progress of science it must be admitted that the principal phenomena of life, respiration, combustion, calorification, digestion, assimilation, and secretion, are an uninterrupted series of chemical reactions.

Among the chemical agents which form part of the immediate principles of the animal world, are some

whose presence is as necessary to certain functions,
 as oxygen is to respiration.

Alkalis, among others, have been proved to be indispensable to the phenomena of endosmose, combustion, digestion, and the secretions; they contribute to maintain the blood in the degree of viscosity necessary to keep it fitted for the endosmose, exosmose, and different compositions and decompositions which constitute existence; they give to the saccharine and amylaceous matters introduced by alimentation the possibility of combining with the oxygen, and assisting in the functions of respiration and calorification; they fluidify the elements of the bile, prevent them from thickening, concreting, or forming calculi; they emulge and saponify the fatty matters, maintain the intestinal digestions, facilitate the secretions, and thus preside over all the acts of nutrition and assimilation.

VII

Mineral waters charged with alkaline principles are therefore fitted to maintain or re-establish the conditions necessary for the integrity of the health.

And in the first rank of mineral waters must be placed the Vichy springs, which are those which contain the greatest quantity of mineralizing principles. Bi-carbonate of soda exists in them in so considerable a proportion flut it must be admitted as the principal

and essential element of their action. In that respect the therapeutic effect is quite in harmony with the analysis, for the strongest springs are those which contain the most alkaline salts. The other salts are found in them in such minute doses that it has so far not been possible to fix their efficacy in a precise manner.

Nevertheless the artificial water composed of bicarbonate of soda alone, fatigues the stomach much more, and does not produce results so prompt and sure as the natural water, especially when drunk at the springs, That depends in a great measure on the mineral water containing the soda salt entirely in the state of bicarbonate of soda, whilst the artificial water is made with a salt not completely saturated, and mixed with neutral carbonate and sesqui-carbonate. Moreover there may exist between the numerous and varied elements which constitute the springs, a sort of special combination which makes of the Vichy water something more than a simple alkaline solution, and gives to it particular properties.

Thus the high temperature of the Vichy springs, the large proportion of bi-carbonate of soda and of carbonic gas they contain, render them, among all others of the same class, the most valuable for therapeutics. The remarkable organic modifications they produce, and the influence they have on certain maladies, cannot be contested.

They are used as a drink, and for baths and douches.

The most favorable moment for drinking them is the morning; the stomach is then entirely free from food, and is better adapted to absorb the mineral liquid. The waters should be drunk at the spring, as all their efficacy is thus more surely preserved. An abuse of them should be avoided, for if they may be tolerated in very large doses by some patients, they may be very difficult to support by others. Their effects are an increase of the appetite, a more prompt and easy digestion, more complete assimilation, more free and copious urine, improvement of the nutrition, increase of strength, and a general feeling of physical comfort.

Ancient writers have erroneously attributed to them purgative properties, and according to most observers they rather produce constipation. It is only in some exceptional idiosyncrasies, or particular affections of the digestive organs, or in fine by an abuse of the waters, that they produce purgative effects.

In baths they give fresh activity to the functions of the skin, increase the perspiration, re-establish former evacuations and eruptions, and even provoke an artificial exanthema when the immersions are over prolonged. The baths exercise a double action: they stimulate the cutaneous organization, and penetrate the economy with mineralizing principles by absorbtion through the skin. Consequently it is necessary to complete the action of the waters as a drink, by baths.

The waters drunk and in baths act on the general economy; the douches are a local stimulant; there are douches of several kinds, ascending, descending, and Scotch, that is alternately hot and cold.

VIII

Besides the exciting properties common to most mineral waters, those of Vichy possess a specific action of their own; that is the chemical modification they determine in the system by the introduction of alkaline salts.

With all patients, the secretions, even those which before were naturally acid, like the urine and the perspiration, promptly acquire alkaline qualities whatever may be the nature of the malady, and whichever may be the spring used.

M. Darcet has made a great number of observations which demonstrate with what facility those waters render the urine alkaline; the alkalinity is more or less marked and prolonged according to the quantity of the waters drunk, the number of baths, or the constitution of the individuals themselves. Thus most persons who take every morning four or five glasses, and a bath daily, are sure of having the urine alkaline so long as they employ the mineral waters.

Experience has shown that the urine may remain alkaline for months, not only without producing any ill effects, but, on the contrary, while contributing to the relief and restoration of the health.

The nature of the secretions should be considered as the expression of what is going on in the entire economy; it is not possible to witness the modifica-

tion of the secretions, without admitting that of the centre in which those secretions have their origin. The blood is modified like the secretions, and is more charged with alkaline principles; but if we remember that the quantity of alkaline elements is much more considerable than that of the acid elements in the humours of the economy, and that the organic reactions and mutations are accomplished in a centre normally alkaline, it will be understood that even an excess of alkalis will involve lesser, and less rapid dangers, than acid elements, and that animals may take into the system and preserve a much greater proportion, without causing prejudicial modifications in their general state of health.

IX

It must not be supposed that the alkalinity of the urine is a phenomenon of elimination, similar to that observed in many alimentary substances, medicinal or toxical, and that the bi-carbonate of soda is to our organs a foreign body which they hasten to throw off. The soda cannot be considered a foreign body not assimilable in the economy; on the contrary, it forms part of the immediate principles which cooperate in the formation and maintenance of our nature. It should therefore remain in sufficient quantity to balance the chemical reactions, its proportion cannot vary without giving rise to serious disorders, but an

increase will be less prejudicial than a diminution, because the effects of an augmentation may be counteracted by the abundance of the secretions, whilst the effects of the diminution will not find in the animal economy any compensation or remedy. It may indeed be admitted that secretions eliminate as a foreign body an excess of alkali, but not the alkali itself, for in that case the organization would tend incessantly to eliminate one of its principal constituents, which is physiologically impossible in a normal state. Whatever may have been said of that elimination of the alkalis by the secretions, that phenomenon signifies that the blood is more alkalized than when the urine was acid, and that the economy may bear a large proportion of alkaline salts without the health suffering from it, as is shown by the herbivora whose urine is always strongly alkalized.

It is only after having satisfied all those requirements of chemical composition and decomposition, that the alkaline salt of the Vichy waters mingles with the urine, not in the state of simple carbonate, or sesqui-carbonate, as has been pretended, but in the state of non-decomposed bi-carbonate.

X

However, it cannot be a matter of indifference to change the secretions of the body and the chemical centre in which the principal phenomena of nutrition are accomplished. What limits should be observed to determine the modification exactly necessary to combat the unwholesome tendency, and to re-establish the normal constitution of the humours?

Magendie and Trousseau have called the attention of medical men to the abuse of alkalis; they have shown that alkalis taken in large quantities exercise an influence on the composition of the blood, render it more fluid, discolour it, cause cachexy, paleness, a general bloatedness, passive hemorrhagia, and an irremediable wasting away, giving rise to accidents much more serious and incurable than those of the malady itself, and causing as much injury as the abuse of mercury, iodine, and ferruginous substances. Those considerations are perfectly just, the abuse of any active medicine is to be feared, and in that respect an abuse of the Vichy waters cannot be made with impunity. But we must at once declare that at Vichy has never been witnessed that alkaline cachexy that funereal procession of accidents, which constitute, not a medication, but a real poisoning, as Dr Durand-Fardel has justly observed. The abuse, supposing that it existed, is counteracted by the abundance of the secretions; the double current of introduction and elimination, continuously renewed, permits the proportion of alkaline elements to be increased to enormous doses without inconvenience.

However, if, in certain pathological cases, and in certain constitutions, the daily imbibing of a large quantity of alkaline drink may be supported

without inconvenience, and even with advantage, in other circumstances of malady or regime, even very minute doses cannot be admitted without accidents.

That difference arises from the composition of the liquids in the economy of the persons making use of the waters: a succulent alimentation, alcoholized and almost exclusively animal, an obstructed perspiration, a deficiency of muscular exercise and intravisceral combustion, generally give rise, with rich and sensual persons, and with all the inhabitants of large centres of population, to a predominance of the acids, and an excess of nutritive and plastic elements, which produce gout, rheumatism, gravel, plethora, etc., and which maladies find relief and cure in an alkaline medication. Whilst an insufficient or almost exclusively vegetable food, and exaggerated perspiration, in the inhabitants of rural districts, fever, putrid affections, etc., in certain invalids, have sufficiently modified or impoverished the humours, for even a small addition of alkaline elements not to be easily supported.

XI

The Vichy waters in rendering the blood more alkaline cause it to lose a part of its coagulability; they attack the albumen and the fibrin and bring about promptly the dissolution of those substances. If the blood, having become more fluid, moves with more

liberty in its channels; if, besides, it has acquired the property of dissolving the two principal elements which form the basis of most chronic congestions, a near approach has been attained to a knowledge of the mechanism by which the Vichy waters are dissolvent, resolutive, antiplastic and disobstruent.

It is therefore of extreme importance to distinguish well the double action, tonic and chemical, of those waters, in the application to be made of them for the treatment of different maladies.

By their exciting and tonic properties they are counter-indicated in all acute inflammatory disorders, in cases in which chronic inflammations have a tendency to recover an acuteness, and in those in which the viscera are subject to serious disorganization, the progress of which is generally aggravated by anything that accelerates the circulation; on the other hand they are favourable in chronic affections, if it is required to give a particular stimulus to the organs, promote the circulation, excite the secretions, or regulate nutrition and assimilation.

By their chemical properties they are suitable in all cases of congestion, obstruction of the viscera, biliary calculi, disorders of the liver, gravel, urinary calculi, chronic cystis, gout, rheumatism, diabetes, etc., etc. But they should be employed with great reserve and prudence with anemic or cachectic persons, who, while deriving advantage from their stimulating virtues, have to fear a chemical modification which would aggravate their state.

They would appear also to be feared in certain maladies which have for effect a too great tenuity or dissolution of the blood; practical observation, however, shows that they produce favourable modifications in lymphatic, scrofulous, or tuberculous constitutions, in convalescence, albuminuria, etc., etc.

The ferruginous principles which exist in the Mesdames spring explain the success obtained in chlorosis, amenorrhœa, etc., etc.

However, the action of the waters is eminently complex, and it is often very difficult to specify precisely what share is due to the chemical combinations produced by the mineral water, and what to the physiological reaction of the organs.

XII

The Vichy springs, considered from the point of view of the results furnished by chemical analysis, present an analogy and an identity of composition from which might be inferred a similar therapeutic identity. They are not however all supported equally well by patients, and they exhibit notable differences in their action on the organs.

- « The Vichy springs » says M. Lucas, « present in « their medical employ differences much more im-• portant than might be supposed from the chemical
- « analysis, and although it is difficult to establish à-

« priori the cause of those differences, numerous *«* observations, repeated during the last twenty-three *«* years, leave me in no doubt on that subject. »

§ — The Grande-Grille spring, thus named because it is surrounded with an iron railing, is situated at the eastern extremity of the northern gallery of the great thermal Establishment. It supplies a great part of the water bottled and exported to the different countries of Europe; it is only employed as a drink, and is of a temperature of from 39 to 40 degrees centigrade. (102.2 to 104. Fahrenheit).

It is administered with success in lymphatic affections, disorders of the digestive organs, congestions of the liver and spleen, visceral obstructions, biliary calculi, gravel, etc., etc. It has more exciting properties than the springs which surround it; thus D^r Desbrest formerly said of it: «This spring should be preferred whenever it is required to stir the human machine, to act more efficaciously on it, and to give the fullest working to its organs. »

§ — The Grand-Puits carré, and Petit-Puits carré, or Puits Chomel, springs are in the middle of the northern gallery, and have a temperature of from 40 to 44 degrees cent. (104 to 111°2 Fahrenheit.) The Grand-Puits is almost exclusively employed for the bath service. The Puits-Chomel is reputed to possess special properties for certain affections of the chest and stomach.

Those two springs, which are in a certain measure

mutually dependant on each other, are employed in baths and as a drink; in the latter case they are often reduced with milk or gum water.

They are prescribed for persons who suffer, not only from the affections specially treated at Vichy, but also from pulmonary catarrh, nervous dyspnæa, or symply from a susceptibility of the respiratory organs.

They are supported by patients whom certain counter-indications do not permit to drink other springs without inconvenience or danger.

The Hôpital spring derives its name from its proximity to the civil Hospital on the place Rosalie. Its temperature is 35 degrés centigr. (95 Fahrenhiet), and it has much analogy with the Grande-Grille spring, but it is less stimulating and more suitable to patients who are delicate, impressionable, nervous, or disposed to congestions and hemorrhagia. It acts principally in affections of the digestive organs, weight on the stomach, difficult digestion, want of appetite, gastralgia, dyspepsia, etc.

The difference between the therapeutical properties of the *Hôpital* and *Grande-Grille* springs disappears when the waters travel in bottle; those of the *Grande-Grille* are then suitable in many cases in which they would not be applicable at Vichy.

§—The Lucas and Acacia springs, situaded opposite the military hospital on the road to Cusset, at about a hundred metres from the thermal Establishment, yielded only very small quantities of water before M. François executed works of canalisation at seven metres below the surface of the ground. In consequence of those works the two springs united now yield about 150,000 litres daily.

That water presents more than any of the other springs a slight smell of hydro-sulphuric acid, which is only observable near the orifice, and which disappears entirely when the water is transported to a distance. It contains more mineral substances, and by its chemical composition and its therapeutic effects it resembles much the water of the *Cclestins* springs.

§ The Celestins or Rocher spring is at the extremity of the old town on the right bank of the Allier; it is reached by the bank of the river or by the steps cut in the rock formed of the calcareous sediment deposited by the waters. Now of very small volume, and of a temperature of scarcely 15 degrees centigrade (59 Fahrenheit), it presents a slight excess of carbonic acid and of mineralizing principles, furnished especially by the silica and bi-carbonate of soda. Although more exciting, it is more agreable to drink, and is often more easy to support in consequence of its low temperature. It is not suitable for nervous and irritable persons or hysterical females subject to spasms etc.; it is indicated for the affections of the kidneys, or bladder, for gravel, urinary calculi, gout, and diabetes.

There are no longer any fears of this spring being dried up; the company to which the Vichy springs have been conceded, have purchased the adjoining field, and under the direction of Government engineers

have made researches which have brought to the surface of the ground, and in abundance, waters exactly similar.

§ — There existed at Hauterive, a village about four miles distant from Vichy, on the left bank of the Allier, two springs, long known and drunk by some inhabitants of the locality. One of those springs having ceased to flow to the surface of the ground, the proprietor M. Brosson, had borings made which opened gushing springs, the approximative yield of which is eighty-six cubic metres per twenty four hours. Notwithstanding their difference of temperature, which is much lower (from 15 to 16 degrees centigrade), those springs no doubt belong, from a geological point of view, to the general group, and present much analogy with the Vichy waters, especially with the Celestins.

The springs and thermal Establishment of Hauterive, purchased by the State, have been conceded to the new Vichy company; the same may be said of the Brosson spring, which, opened in 1844, between the park of the great thermal Establishment and the right bank of the Allier, now pours the whole of its waters into the reservoirs of the bath service.

§ The Mesdames spring, obtained by boring, is on the road from Vichy to Cusset, following the banks of the Sichon. The waters of that spring are ferruginous, alkaline, and gazeous; their temperature is only 15 to 16 degrees centigrade; they have a marked atramentous flavour, and possess very energetic and quite special medicinal properties, due to the ferruginous principles they contain.

They are very salutary for weak and debilitated constitutions, convalescents, fever patients, chlorotic and lymphatic persons, etc.

XIII

Such are the indications which practical experience in the therapeutic application of the different Vichy springs seems to have sanctioned. However, it will be understood that numerous modifications may be easily introduced into them. From the analogy between their medical virtues, and their chemical composition, those waters must in many cases offer the same advantages, and the same results; the only choice then lies between the warm or cold, the strong or weak, or those the most easily supported.

By their stimulating and at the same time alterative properties, the same springs often present the greatest contrasts; according to the constitution of the persons and the nature of the malady, they produce calm or excitement, sleep or wakefulness, diarrhæa or constipation, soothe or increase certain pains, strengthen or weaken, fatten or reduce, etc.

It is therefore always absolutely necessary to charge a medical man with the direction of a treatment which be alone can properly appreciate.

XIV

A question often discussed and much controverted, is whether wine, milk, and the least drop of vinegar in the preparation of food, and fruit especially, should be banished during the whole duration of a season at Vichy. It is thought that those substances, which are more or less acid, may impair the efficacy of the thermal treatment.

M. Mialhe examined that question in a memorial read in 1866 before the Paris Society of Medical Hydrology. He put the following three questions:

First question. — Have the organic acids administered at the same time as the Vichy waters, the result of destroying the alkalizing effects of the Vichy waters by neutralizing them?

Second question. — Are the organic acids after their saturation by the Vichy waters, all susceptible of being destroyed in the organism?

Third question. — When at the same time as the Vichy waters is taken fruit or acid drinks, is the alkalization of the economy stronger, weaker, or equal to that produced by the Vichy waters administered alone?

After having developed very important considerations, M. Mialhe summed up as follows the results of his experience. There exists three classes of organic acids; the first contains stable acids impervious to oxygen, and which for that reason resist the physiological combustion, and appear unaltered in the secretions.

The second comprises acids with a great affinity for oxygen under the influence of alkalis, but which, by a partial oxydization, produce fresh acids more fixed than those which gave rise to them, and which may be detected in the urinary liquid.

Lastly, the third class comprises acids which, by the intervention of alkalis, absorb the oxygen condensed in the blood, in sufficient proportion to be entirely oxydized or burnt.

Organic acids of the first two classes should be proscribed from the Vichy diet, for the administration of them would have the effect of destroying the alkalizing action of those waters, by producing salts indecomposable in the blood. When there is any reason to avoid increasing the normal acidity of the urine, the prescribing of that kind of acids should be avoided, even as a medecine, for each proportion of acid introduced into the organism would deprive the blood of an equivalent proportion of alkali, and largely increase the acidity of the urinary liquid.

Acids of the third class may, on the contrary, form part of the diet at Vichy, and, in fact, acetic, lactic, citric, malic, tartaric, and other vegetable acids, contained in the food and drink, are entirely destructible in the organism, (1) so that, when administered with

⁽¹⁾ Oxalic acid is an exception to that rule, and may therefore, by combining with the lime, produce calculi.

Vichy water, the salts which result from that mixture undergo in the torrent of the circulation, a complete oxydation, which transforms them into water, carbonic acid, and finally into alkaline bi-carbonates, which may be found in the urine, which they render alkaline in the same degree as the Vichy water they represent.

From which it results that excepting in cases in which the Vichy water is administered as an absorbent of the gastric juices, the action of that mineral water is the same, whether, during its ingestion, the use of wine, vinegar, or very acid fruits, like lemons or currants, is either permitted or proscribed. More than that, if during the employ of the Vichy water, use is made of fruits or drinks, containing, not acid in almost a free state, but acid alkaline salts such as are contained in strawberries, grapes, and cherries especially, the alkalization of the economy is much more marked than if the Vichy water had been administered alone.

Far therefore from proscribing from the Vichy diet food and drink which contain acid alkaline salts; it is on the contrary advisable to employ them whenever the functions of digestion and assimilation permit. Such food and drinks are especially suitable in the treatment of maladies which require the Vichy water in large doses; by using them a sufficient alkalization is attained with a lesser ingestion of the mineral water. For like reasons, in the cure of gravel by cherries, and especially in the treatment of the same malady

with grapes, more prompt and satisfactory results will be arrived at by joining to that treatment the use of a certain quantity of Vichy water, which by saturating the acid alkaline salts the cherries and grapes contain, would have the effect of assuring their entire physiological combustion; for the fact must never be forgotten that it is solely by the intervention of alkalis that the combustible vegetable acids are oxydized and burnt, and become real calcrific elements.

INDICATION OF THE VICHY WATERS

§ — Disorders of the stomach. — At least two thirds of the patients to be met at Vichy, go there to obtain from the waters a cure or relief from disturbed functions of the digestion. With most medical men, as well, as with most other persons, the Vichy waters constitute a sort of panacea for what is called disorders of the stomach. That is true for the great class of maladies already examined in many publications under the name of dyspepsia; but apart from those cases it is necessary to establish distinctions, from the point of view of the opportuneness of the Vichy waters. We are about to attempt to present a sort of nosological table of the different affections of the kind which we have observed at Vichy, and to indicate what we call the thermal prognostics, that it is to say the relative degree, or the sense, according to which each pathological form appears to be of a nature to be influenced by the thermal treatment (1).

Many persons when questioned as to their state of health reply that they digest badly. They have generally little or no appetite. After eating, or some time after their meals, they feel a sensation of weight, more or less painful, in the epigastrium, with gaping, flatulency, acidity sometimes, headache general weakness and depression of spirits. That lasts for an hour or two, or longer, according to the length of time occupied in the process of digestion; this being effected, the inconvenience disappears, until a fresh digestion revives the unpleasant symptoms.

The different phenomena we have mentioned may manifest themselves in the highest degree; but almost all may also disappear, so that sometimes the uneasiness occasioned by the digestion is limited to certain gastric phenomena, and sometimes, which is indeed still more rare, these latter are quite absent, and the presence of food in the stomach is only marked by headache or pains in the back; from the existence, absence, or combination of those different distant phenomena, result characteristics of a vary varied nature.

But in all cases this common circumstance is remarked, that from the mere fact of the digestion, and the difficulty or delay with which it is accomplished, all the disorders in those functions arise. In the absence

⁽¹⁾ Durand-Fardel: Lettres médicales sur Vichy 3rd ed.; pages 76, and following.

of food in the stomach the cause of the disorder is removed.

It is that order of facts which, according to the definition of Cullen, we comprise under the name of dyspepsia.

But this also may happen: in the greater number of cases the symptomatic manifestations are limited by the period and duration of the digestion, and even the digestion is not troubled when certain hygienic, dietesic, or other precautions are taken. With a certain number of sufferers those inconveniences, being frequently repeated, the effect they produce on the general economy, and the nervous system in particular, and the hinderance to the process of assimilation which is the result, end by impairing the general health to such a point as to produce a real cachectic state.

But the most practical distinction that can be made in all those cases is that which results from pathogenical considerations. Dyspepsia is rarely occasioned by direct causes. The abuse of the pleasures of the table does not usually produce that result. The causes of dyspepsia almost always arise from circumstances which have, with the accomplishment of the digestion, only an indirect but yet necessary connection.

Painful neurosis of the stomach, or gastralgia, manifests itself under several well defined forms of which we may name the following:

The typical form is the attack of gastralgia or cramps in the stomach. We need not describe here those crises, usually so violent, and which may attain the torturing character of hepatic colics, of half an hour or several hours duration, general accompanied with vomiting, commencing rather suddenly, and ending the same, and producing a sluggishness, and especially a considerable diminution of the pulse.

At other times it is cardialgic pains, not continuous, but habitual and appearing at indeterminate periods, and not assuming the character of paroxysms. They are of a bearable intensity, generally occur fasting, and are rather relieved than reproduced by the introduction of food into the stomach.

There are certain kinds of gastralgia in which there exists continuous cardialgic pains, with or without paroxysms, and which are often not increased by taking food. They frequently occur to chlorotic young girls. That pain, generally increased by pressure, almost always limited, especially by the sensibility of the pressure, to a very restricted space towards the points of the xiphoid cartilage, rising, sometimes, under the sternum, and accompanied with dyspnœa, never attains the violence of gastralgic crises, and is often more difficult to support from its persistance than from its acuteness.

Lastly there is a form of gastralgia not less common with chlorotic young girls, in which the introduction of the least food, or food of a certain kind, into the stomach, brings on excessive pains often of very long duration. In this case, as in dyspepsia, the symptomatic manifestations depend on the presence of food, but they then consist essentially of the pain, which does not exist in the dyspepsia itself.

Now, there is a certain order of facts in which we find combined the symptoms of both gastralgia and dyspepsia, and which we will call dyspeptic gastralgia, or gastralgic dyspepsia, according to which of those forms predominates or represents the element from which the other has proceeded. The analysis of these facts is very easy to be understood.

It may happen that, with a dyspeptic patient, and in consequence of the disturbance caused by the slowness of the digestion, the local nervous system becomes excited to such a point as to give rise to gastralgic phenomena; or it may happen that with a gastralgic patient the return of the pain ends by troubling the mechanism of the digestion, and determining a dyspeptic state. That apparent confusion of symptoms and morbid elements arises simply from the fact that the forms, according to which the organic elements of the stomach and the functions they put in motion may be disturbed, are very complex, both in their combinations and their mutual reactions, and above all do not necessarily adapt themselves to a nosological arrangement.

Gastralgia, and dyspepsia, however distinct they may be from each other, may therefore meet on the same ground, and thus increase the therapeutic indications which belong to both.

Dyspepsia, is almost always advantageously modified by the thermal treatment of Vichy.

The thermal treatment must be considered at the same time with relation to its local action on the

digestive organs, and to its general effects on the entire organism and the other morbid states which may coexist.

When the dyspepsia is simple and idiopathic it is generally cured in a complete and easy manner by the use of the Vichy waters, which then exercise a special and direct modifiying action on the digestive apparatus.

But dyspepsia is most often symptomatic with some other morbid, general, or local state. To obtain a cure of the dyspepsia in that case, two things are necessary; first that the predominant affection should be favourable to the therapeutic action of the Vichy waters, next that the thermal treatment should be especially directed to that other disorder. Those two conditions being observed, advantageous results will be invariably derived from the treatment; but a complete cure of the dyspepsia will not always follow, at it is often difficult to entirely eradicate those chronic or constitutional affections on which dyspepsia so frequently depends. Patients are then in the position of persons who cannot or do not know how to get rid of vicious hygienic conditions.

Whether the patient relapses into his former bad state, or the organism into abnormal conditions, the result is nevertheless an almost inevitable return of the dyspeptic symptoms, whatever effect the treatment may have first had on them. But even then, such is the efficacy of the Vichy waters, as a remedy for dyspepsia, that important and durable palliative effects are almost always obtained.

In fine, it may be affirmed that the Vichy waters, on condition that they are adapted to all the existing indications, and that to the various modes of administration which they present, are added, if necessary auxiliary therapeutic means, offer immense resources against dyspepsia and the morbid states which usually accompany it.

With respect to gastralgia, the only form in which from the thermal treatment of Vichy is obtained really advantageous results, is that of determined crises, cramps in the stomach, and paroxysm of gastralgia. In no case of that kind have we seen the effects of the treatment fail to produce either a cure or at least a considerable attenuation of those painful accidents.

On the other hand the actual existence of neuralgic symptoms generally counter-indicates the employ of the thermal treatment, which rarely fails to aggravate them.

Two conditions are therefore requisite for the Vichy waters to be usefully employed in gastralgia. On the one hand the gastralgia must proceed from organic or functional causes of a nature to be effectively modified by the waters; and on the other it is important that neuralgic phenomena do not exist, and are thus not in danger of being aggravated by the treatment.

That double circumstance may in fact be met with in gastralgia with periodical attacks.

§—Hepatic colics are one of the maladies in which the therapeutic effects of the Vichy waters may be employed with the greatest certainty.

It is incontestable that the Vichy waters constitute a treatment remarkably efficacious for calculous hepatic colic, that malady against which medecine offers so few resources. In what manner do they act? Is it by dissolving or rendering more liquid the biliary concretions, probably by the aid of the bile, which being charged with the chemical principles of the Vichy water, would introduce into the biliary vesicle the materials of that dissolution? That opinion is much controverted (Durand-Fardel, Willemin); the fact is however certain that under the influence of the thermal treatment the expulsion of the calculi is often singularly facilitated, sometimes without pain, but more frequently with colics, which occur even at Vichy, or immediately after the thermal treatment. Sometimes even that effect of the thermal treatment is so strong that patients are seen to remain continuously under the imminence of colics which recur at short intervals, and are especially renewed as soon as the limits of an excessive reserve in the administration of the waters is for a moment exceeded. An extreme perseverance is required to continue the remedy amidst such extreme pains, such violent crises, and the discouragement or disquietude which siezes on the patient; at the same time must be observed infinite delicacy in the administration of the waters, incessant circumspection in the diet, and a careful and opportune recourse to the means so often sterile, which therapeutics may oppose to those painful phenomena. Besides, the hepatic colics which occur during or immediately after the thermal treatment, precisely announce, almost always, a considerable attenuation of the malady, if not its entire disappearance, and we have never had cause for regret to have insisted in the cases to which we allude, on the use of the waters, at least within the limits it seemed to us possible to attain. We must add that we have known those hepatic colics occurring in the course of the thermal treatment, or immediately afterwards, attended much more often by the expulsion of biliary calculi than the previous colics.

§ — Gout and rheumatism are closely connected with gravel and urinary calculus; those maladies fraternize by the alternative, the coexistence of their attacks; by the common element of their organization, uric acid and its compounds; and by the identity of their development, from the same causes - an excess of nutritive materials, intemperance, a sedentary life, etc. Whatever may be the opinion, or the discussions of medical men on the nature of gout, its crises, and even the danger it presents, the result of numerous and well authenticated observations is that the medication of the Vichy waters, aided by a suitable diet, produces the most advantageous effects in the treatment of gout. The waters, it is true, rarely succeed in radically curing the malady, and in some cases, particularly in those of confirmed constitutional gout, they are almost powerless; but in general they diminish the frequency, the duration, and the intensity of the attacks, and attenuate, or often put an end to the local accidents which are the effects of the paroxyms. Although the treatment cannot always dissolve the nodes and other tophaceous concretions deposited around the joints, it triumphs easily over the congestions which arise from stiffness of the ligaments and the contraction of the muscles. If prudence advises the suspension of the treatment on the approach of, or during an attack, it has nevertheless been frequently observed that when a patient has an attack of gout while taking the Vichy waters, the pains are less acute and of shorter duration than at other times.

Lastly, gouty people support remarkably well the Vichy waters; they generally drink the strongest, the Celestins, and often in considerable quantities, without suffering any inconvenience or ill effects. For them it is important, after leaving Vichy, to continue the use of alkaline drinks, if they would not lose rapidly the benefits of the thermal treatment, which, in order to ensure success, should be repeated for two or three consecutive years, accordingly as required.

§ — With respect to *albuminuria*, as for gout, it is sufficient to indicate the practical results obtained during the last few years.

The passing of albuminous matter into the urine is designated under the name of albuminuria or albuminous nephritis. The general character of this malady is: — A considerable impoverishment of the components of the blood, a serious disturbance of the circulation, partial or general dropsy. Whether the vitiated state of the humours in the system is primitive

or secondary, whether they precede or follow the disease of the kidneys, they certainly constitute, in any case, the principal danger, against which all the resources of the art must be employed without loss of time. Clinical experience has proved that albuminuria, arrived at a certain degree, and not complicated by any serious organic disorders, may still present the most favourable chances of a cure, and that then the only treatment to be opposed to it is a tonic, strengthening, and strongly animalizing regime, joined with generous wines, alcoholic drinks, bitter and ferruginous preparations, and mineral waters; fitted, in fine, to revive the digestive organs, regenerate the albuminous elements, and reconstitute in a normal state the humours of the system.

Now, the Vichy waters by the stimulating effects produced by them on the skin and the gastro-intestinal membrane, and by the activity given to the functions of assimilation, innervation, and secretion, have appeared o combine the most favourable conditions for opposing the wasting away of sufferers from albuminuria. Some patients have been sent to Vichy with doubt and circumspection, and have soon been relieved to such a degree, and have presented cures so marvellous, that the Vichy waters must be considered as one of the most powerful auxiliaries in the treatment of albuminuria.

^{§ —} To appreciate the action of the waters in cases of gravel, urinary calculi, and diabetes, it is neces-

sary to examine the different works which have of late years contributed to throw a light on the nature and treatment of those maladies.

GRAVEL, URINARY CALCULI.

§ — Long before any chemical theory on which might be based the treatment of gravel and urinary calculi, it had been admitted that the use of alkaline drinks, and especially of the Vichy waters, were advantageous in most calculous affections.

The patients suffering from gravel or calculi, who go to Vichy to take the waters, feel a very sensible relief from the first days, the urine becomes alkaline immediately; being secreted more abundantly and without pain, it dissolves and carries off the glairous and purulent matters resulting from an irritation of the mucous membrane; it soon ceases to be thick and fœtid and becomes limpid, while at the same time hematuria, nephritic colics, pains in the kidneys, uretha and bladder, and the disorders caused by the presence of calculi, are relieved and suspended; the sleep, the appetite, and the strength revive, and patients, who on arriving could scarcely stand on their legs, are able, in a few days, to indulge in salutary exercise.

§ - The power of the Vichy waters, and of alkaline

solutions in general, to strongly alkalize the urine, led rationally to the idea of the dissolution of the vesical calculi, since by that means they were placed in contact with a liquid which might be supposed to exercise on them a chemical action.

The dissolution of calculi by a kalis had been admitted from the earliest times; the remedies proposed as lithortriptics, such as, the shells of snails, so much vaunted by Pliny, the famous specific of Miss Stephens, Wyhtt lime water, Saunders'potion, Mascagni tisane, Brandes solution of magnesia, etc., etc., all owe their proved success to the dissolvent action of carbonates of soda, potash or magnesia, found in them, or which are formed by them after their ingestion into the system.

It had moreover been ascertained that alkaline solutions, carried direct into the bladder, were capable of attacking the calculi, and reducing the size of them. Berzélius had sanctioned with his scientific authority those essays, often successful, by saying in his Traité de Chimie, vol. 7, page 134:

"The best injection is a luke warm solution of one part of potassic carbonate in from 90 to 100 parts of water, to which is added a little vegetable mucilage. That liquor acts on the calculi, whatever may be the composition of them."

It was therefore already proved by practical facts that alkalis, either as drinks or as injections, exercised a most favourable action on the calculous secretions, when D^r Petit undertook a series of very remarkable

experiments to prove that the Vichy waters, as mineral waters strongly charged with bi-carbonate of soda, were capable of dissolving and disaggregating all urinary calculi.

« The Vichy waters » says M. Petit in his remarkable treatise on the mode in which the mineral waters of Vichy produce their effects « do not solely act by increasing the secretion of urine and by that means facilitating the expulsion of the gravel; their real and most positive effects in those cases are by communicating their chemical qualities to the urine, and by presenting to the gravel a liquid in which it may become naturally dissolved or disaggregated in a space of time proportioned to its size and chemical composition. •

« Too much attention, adds M. Petit, cannot be paid to the part played by the mucous membrane of the bladder which mingles with the calculous substance, interposes itself between the molecules, increases their adhesine strength, and in a word acts as a cement. There is consequently in the same calculi a sort of agglutination of the animal and saline matters. The waters dissolve the animal matter, and as a consequence separate the saline parts, which deprived of their cement, are deposited in small scales, and expelled with the urine; in that manner the waters may act on the phosphatic calculi, especially on those of ammoniacal-magnesian phosphate, as well as on the calculi of uric acid. »

Therefore, without having any chemical action on the elements of a calculus, whatever may besides be its composition, the Vichy waters, by the disaggregation of the different ingredients of the calculi, may gradually diminuish them, and cause their natural expulsion from the bladder.

§ — The experiments of M. Petit were repeated and discussed by commissions of the Academy of Medecine and the Academy of Sciences.

Although the results have been the object of divers appreciations, the reports of MM. A. Bérard, O. Henry, and Pélouze, nevertheless prove certain facts which may be summed up as follows.

1° The mineral water of Vichy acts in an incontestable manner on the calculi of the urinary passages.

- 2° The calculi placed directly in contact with the water of the Vichy springs, present evident traces of the dissolvent and disaggregating action of that liquid; and the calculi retained in the bladder are attacked in the same manner by the urine when it has become alkaline by the use of the Vichy thermal waters, in baths and as a drink.
- 3° Proofs of those facts are acquired by the alteration undergone by the urinary concretions passed by the patients, by the diminution of their size, ascertained by the aid of the catheter or by direct inspection, by the presence of substances in solution, formed to the detriment of the new principles the urine contains, and of the elements of the calculi with which they are combined.
 - 4° The action of the alkaline bi-carbonates is exer-

cised in a still greater degree on the mucous membrane and the animal matters which serve to unite the particles of the calculi, than on the calculi themselves.

5° That dissolution and disaggregation of their principles may have for result either their natural expulsion from the bladder by the urine, or their greater friability, which becomes very favorable to the mechanical efforts of lithotrity.

6° The fact must be admitted as a general proposition that during the administration of the Vichy waters the state of the calculi improves, and that the urinary passages are not in any way impaired so as to render subsequent surgical operations more serious.

§ — Thus the efficacy of the Vichy waters against gravel and urinary calculi must be considered as a truth demonstrated.

A very serious objection has however been raised: it is pretended that the use of the mineral waters might promote and increase the deposit of phosphates of lime and magnesia in the urine, add that deposit to the different calculi already existing in the bladder, and thus produce alternating calculi (Marcet, Prout, etc.)

Although that objection has been victoriously answered by several writers, and especially by M. Petit, and although it is not based on any scientific demonstration, yet it is still accepted by some practicians. For that reason the necessity for considering the treatment of gravel and urinary calculi by the Vichy

waters, with developments sufficiently complete to remove any prejudice or error and carry conviction into all minds.

§ — An incontestable fact is the improvement in the health of patients who make use of the thermal waters of Vichy, although they may not have identical affections with respect to the seat, the volume, or the chemical composition of the gravel or urinary calculi.

Gravel and calculi are developed, sometimes with acid urine, sometimes with alkaline urine. Would it not appear logical to treat acid urine with alkaline drinks, and alkaline urine with acid drinks?

The question must be first considered whether science can explain in a satisfactory manner how a same remedy can, in affections so different, offer similar results.

A very distinct line of demarcation should be established between the different kinds of gravel and calculi, admitted by writers; they may be all comprised in two principal groups: 1° Those which are determined by the uric acid and its compounds; 2° those which result from phosphatic deposits of lime, magnesia, or ammonia, forming binary or tertiary combinations.

§— Gravel and uric calculi. — Uric or red gravel, the only one to which the word gravel may be correctly applied, that is to say the only one that arises from a general disposition, and a diathesis of the eco-

nomy, has its origin in an excess of uric acid in the urine.

The uric acid is formed naturally in the humours of the system; it should, in a normal condition of health, pass to a more advanced state of oxydization to produce the urea; but if food, sedentary habits, an insufficiency of exercise and oxydization, increase, on the one hand the proportion of uric acid, and on the other diminish its chance of transformation into urea, it is precipitated in very large quantity in the urine, from which it separates in the form of a brick coloured sediment, and in molecules of a more or less considerable size, which, uniting and agglutinizing by the aid of the mucous membrane, may form calculi in the kidneys or bladder.

In that uric diathesis the urine preserves its natural colour of a more or less dark yellow; it generally remains limpid, and is always more or less acid.

The first effect of the Vichy waters is to render the urine alkaline by introducing into the system a large quantity of bi-carbonate of soda. The uric acid, which has the property of dissolving in alkalis, decomposes the bi-carbonate of soda wherever it meets with it, siezes on its basis to form a urate of soda, which, being more soluble than uric acid, is dissolved in the urine, and is next expelled with it.

In consequence of that continual dissolution of the uric acid by the bi-carbonate, there is not only an obstacle to the formation of gravel and uric calculi, but there is also a manifest action on the calculi of

uric acid or urate of lime already formed in the kidneys or bladder; those calculi become covered with a coating of urate of soda, the unctuous contact of which modifies the ruggedness of their surface, and facilitates their passage through the urinary organs. This coating of urate of soda, by degrees as it dissolves, is again formed by the contact of a fresh alkaline liquid, and by that successive destruction the calculus may become sufficiently reduced in size to be expelled by the ordinary passage, or even be dissolved when it is very small.

All observers are in accord in saying that one or several seasons of the Vichy waters favours the expulsion of the gravel and appears to contribute to prevent the formation of it during a space of time more or less prolonged; in fact the waters not only neutralize the uric diathesis and momentarily prevent it from manifesting itself, but also modify the organic causes of its production by rendering the urine alkaline before its arrival in the kidneys and bladder.

That chemical explanation of the action of the Vichy waters on gravel and urinary calculi, is admitted by every one; experience and theory are in accord in proclaiming in those circumstances, the good effects of the Vichy waters.

§ — But is the case the same with respect to deposits and calculi of a phosphatic basis?

Phosphatic deposits. — The name of white gravel, phosphatic gravel, and catarrhal gravel, is given by general consent to that disorder of the urinary organs

in which muddy, fætid, or discoloured urine, deposits a certain quantity of phosphate of lime, or ammoniacal-magnesian phosphate, sometimes in the form of white powder, sometimes as gravel of an irregular and angular form, and of variable consistency. That deposit in the bladder may give rise to calculi formed of the double or triple combination of those bases, to calculi of ammoniacal-magnesian phosphate, or of a mixture of this latter with phosphate of lime; they are then called fusible calculi and are much more frequent than the first.

In those cases the urine is always neutral or alkaline, and it is certain that gravel of that kind commences with urine not sufficiently acid to hold in solution the saline elements of which it is constituted. It is nevertheless clearly demonstrated to all who have observed the urine of patients, subject to the action of the Vichy waters, that it becomes more clear in proportion to its alkalization, and that in that state it does not precipitate the salts it contains.

§—Notwithstanding the evidence of that important fact it is relative to phosphatic deposits that have arisen the objections, errors, and prejudices, against the use of the Vichy waters.

The greatest divergencies have been produced between very able practicians, and even at Vichy, of the two medical inspectors, the one, M. Petit, who has had the advantage of experiments and of his practical observations, affirmed the benefits of those waters against all kinds of calculous affections; whilst the other, M. Prunelle, proscribed them as dangerous and of a nature to determine the formation of new gravel.

That discussion, as already stated, was submitted to the Academies of Science and of Medicine. The former objections of Prout and Marcet were reproduced; namely, that the Vichy waters, by neutralizing the free acids of the urine, might favour and increase the deposit of phosphates of lime and magnesia, and add that deposit to the different calculi existing in the bladder; and that far from dissolving the calculi already formed they would rather contribute to increase the size of them.

According to MM. Civiale and Lersy d'Etiolles, there would be reason to fear:

- 1° Certain deposits of urate of soda;
- 2º The precipitation of phosphate of lime and of ammoniacal-magnesian phosphate on kernels of uric acid;
- 3° The precipitation of phosphate of lime on calculi of oxalate of lime;
- 4° The formation of a gravel of carbonate of lime and urate of lime so that one diathesis would be made to succeed to another. It is for chemists, as was very appropriately remarked by M. A. Bérard in his report to the Academy of Medicine, to appreciate the theoretical value of those objections.
- § Now, chemical knowledge proves clearly that here is no foundation for those objections. The Vichy

waters cannot in any case produce deposits of urate of soda, because that salt is perfectly soluble; nor can they determine the precipitation of the salts of lime and of magnesia contained in the urine, as will be shown, and when that precipitation takes place, it is quite independently of the Vichy waters.

To properly understand the chemical effects of the Vichy waters we must bear in mind the experiments of M. Darcet, and those of M. Mialhe on the modifications caused in the urinary liquid by the bi-carbonate of soda and the ammonia.

The bi-carbonate of soda — the Vichy water — introduced into normally acid urine, does not cause any precipitate; an exchange of bases takes place to tween the acid phosphates in solution in the urine, and the bicarbonate introduced, so that there is formed phosphate of soda and bi-carbonates of lime and magnesia, all soluble salts and perfectly stable, at the animal temperature, only giving a precipitate by boiling.

The ammonia introduced into normally acid urine gives a precipitate more or less abundant, formed by phosphate of lime, phosphate of magnesia, and by a certain quantity of phosphate of ammonia. The first two were in solution in the urine in the state of acid phosphates, the last was produced at the moment in which the two acid phosphates were transformed into insoluble neutral phosphates, leaving free their excess of phosphoric acid, which has combined with the ammonia.

§ — The urine alkalized by the Vichy waters taken as a drink and in baths, undergoes exactly the same reactions.

Through the introduction of the bi-carbonate of soda, they are clear and limpid, and do not produce any precipitate; the process of boiling expels the exces of carbonic acid which held in solution the bases and balanced the power of the phosphoric acid; this latter, in the presence of simple carbonates, resumes its bases of lime and magnesia, and forms a precipitate to which is joined a more or less considerable quantity of carbonates; — a precipitate exactly similar to that which is formed by heating a mixture of urine in a normal state, and of Vichy water.

The ammonia, added to the alkalized urine, determines immediately an abundant precipitate; the bicarbonates of lime and magnesia, as well as the phosphate of soda, are decomposed, and there is formed insoluble neutral phosphates of lime, of magnesia, and of ammonia, of a nature to constitute the phosphatic triple calculus, called a fusible calculus.

Therefore without as within the animal economy, it is only under the influence of ammonia that phosphatic deposits are formed.

§ — Those are incontestable chemical facts. Let us now consider how they may explain accidents which arise with patients affected with phosphatic deposits.

In the first place the affection of the urinary pas-

sages designated as phosphatic gravel, is not gravel; it does not depend, like uric gravel, on a diathesis or general disposition of the economy; it is quite local and has for its seat the bladder.

All surgeons, and M. Leroy d'Etiolles himself, agree in admitting that the phosphatic deposits are not met with in persons suffering from vesical catarrh, with whom the urine is impaired and is retained in the bladder by an obstacle to its emission, and that the malady called phosphatic, which then manifests itself, is a consequence of the inflammatory state of the bladder.

Now whenever there exists, either from the presence of a calculus, or directly, vesical catarrh, disorder of the tissues, purulent secretion, or retention of the urine, there is formed in the bladder ammoniacal products resulting from the secretions themselves, or from the moleculary transformation of the urea.

Those ammonical products give rise to the same chemical reactions which would result from the direct introduction of ammonia into the urinary liquid in a normal state.

Thus, before their stay at Vichy, patients affected with phosphate deposits, necessarily presented the following phenomena: the urine left the kidneys in a normal state, containing acid phosphates of lime and of magnesia in solution; as soon as it arrived in the bladder it found ammoniacal products which decomposed it, and gave rise to insoluble precipitates of neutral phosphates of lime and magnesia combining

with the phosphate of ammonia, which was expelled with the urine, or becoming agglomerated and forming calculi.

§ — In the malady at that stage the bi-carbonate of soda has had no share; the phosphatic deposits have been produced and organized independently of its presence or its influence.

Will the ingestion of the Vichy water aggravate those circumstances and give rise to more abundant deposits of ammoniacal phosphate?

By no means; it should on the contrary cause them to gradually disappear, at is proved by daily experience.

As soon as the patients take the Vichy water the urine is modified; it loses its acidity, becomes alkaline, contains no more phosphates of lime and magnesia. which would tend to form precipitates in the bladder, for before reaching that organ they have been transformed into bi-carbonates of lime and magnesia, which are soluble salts; the urine would therefore be emitted the more limpid from being more alkalized, if it did not find in the bladder any conditions of decomposition.

Those conditions are the ammoniacal products determined either by the disorder of the tissues, or by the decomposition of the urine itself. In contact with the ammonia the bicarbonates of time and magnesia, as well as the phosphate of soda, are decomposed; there is formed insoluble neutral phosphates of lime

and magnesia, combined with phosphate of ammonia, which produce precipitates, exactly similar to those which existed before the ingestion of the Vichy waters.

Thus the mineral waters have changed nothing in the existing conditions; they cannot aggravate those conditions, but can they modify them?

Certainly, for by introducing into the economy a large quantity of water; by incessantly increasing and renewing the secretion and the flow of the urinary liquids, dissolving the purulent mucosities, modifying the affected surfaces, and thus preventing the formation of ammoniacal productions, they gradually remove all the causes of precipitates, and attack the source of the malady itself.

§—So long as ammoniacal productions exist, the urine remains charged with precipitates; it may be that at the commencement the calculous deposits are more abundant, because, to the salts naturally existing in the urine, are added the salts contained in the mineral water, but by degrees as the membranes become modified, and the ammoniacal production ceases, the urine becomes clearer and ceases to form deposits.

M. Prunelle made a correct observation when be said. « It is in the case of phosphatic diathesis that the patients pass the more gravel in proportion to the quantity of Vichy water they drink. It is formed in the bladder, as for it to come from the kidneys those organs must have a greater capacity than the stomach. » But he was mistaken as to the cause of

those accidents in attributing to the Vichy water what was only due to the presence of ammonia in the bladder. Therefore M. Petit very justly replied: The phosphatic calculi are observed in cases in which no use has been made of alkalis, and if the Vichy waters gave rise to them a greater number of calculi should be found in persons who undergo the alkaline treatment.»

§ — It is therefore impossible to attribute to the Vichy waters and to bi-carbonates in general the least share in the formation of deposits and calculi of double or triple phosphates of ammoniacal lime and magnesia.

It is to the ammonia alone, accidentally created in the bladder, that those precipitates must necessarily by attributed.

In those cases the ammonia, far from being increased, tends to disappear daily by the favourable influence of the bi-carbonates on the impaired tissues.

However if, by an exceptional fact, the Vichy water, administered in a marked proportion, appeared to produce rather an increase than a diminution of ammonia in the urine, it would then be advisable to diminish the dose, or still better to reduce the mineral water by mixing with it common water, the purest possible (1), in order to diminish the action of it.

⁽¹⁾ The water of the Allier, which is one of the potable waters the least charged with calcarcous salts, is one of the best fitted for that indication; it marks only 3° 5 of the hydrotimeter, whilst the water of the Seine, at Paris generally marks from 16 to 17 degrees.

§ — Now what will happen with respect to the phosphatic calculi already formed in the bladder? Can it be hoped that the urine which washes them preserves sufficient bi-carbonatic elements to act on their constituent principles.

Yes, without any doubt, for the quantity of mineral water ingested, if it is sufficient, will respond perfectly to all the requirements of chemical composition and decomposition, and the urine will still contain a large proportion of un-decomposed bi-carbonate of soda, which will act directly on the calculus itself, either by the dissolution of its mucous parts, or by the decomposition of its vulnerable principles.

It has been falsely asserted, recently, that the urine of drinkers of Vichy water does not contain bi-carbonates, but only neutral carbonates. That condition is impossible, for the salts of the urine are only soluble in alkaline bi-carbonates; this may be easily demonstrated; submitted to boiling that urine thickens immediately and produces an abundant precipitate; it is, as already has been said, because boiling destroys the excess of carbonic acid which held the bases in solution and balanced the power of the phosphoric acid; this latter, in the presence of simple carbonates, resumes its bases of lime and magnesia, and forms a precipitate with which combines a greater or lesser quantity of carbonates. Therefore, the urine secreted limpid, and not forming any deposit, contains the mineralizing principles in the state of bi-carbonates.

§ — From what has just been shown, it is not possible to admit that the Vichy waters can give rise to a precipitate of carbonate of lime on the oxalic calculi, as the urine then contains only soluble bicarbonates of lime and magnesia.

Nor can they determine on the calculi of uric acid the deposit of triple phosphates of lime, ammonia, and magnesia, as the circumstances which give rise to alternant calculi are quite independent of the presence of the Vichy waters, which, on the contrary, tend to attenuate them and cause them to disappear.

Besides, it results from direct experiments and practical observations that under the influence of those mineral waters, the calculi composed of uric acid and of ammoniacal-magnesian phosphates, may be destroyed either by dissolution or by disaggregation; that those of oxalate and phosphate of lime may be disaggregated whenever they are mixed with uric acid and ammoniacal-magnesian phosphate in consequence of the action exercised by the alkalis on the uric acid, and of the facility with which they disaggregate the ammoniacal-magnesian phosphate; and that the calculi exclusively composed of oxolate and phosphate of lime, which are happily very rare, might also be attacked either in their basis or in the mucous substance which binds them.

^{§ —} Non-ammoniacal phosphatic gravel. — The ammoniacal phosphatic gravel just referred to, is not, like the uric gravel, the result of a diathesis; it is

due to a local cause in the state of the genito-urinary organs, but it does not alone constitute all white gravel. There are certainly, says M. Mialhe (1) two sorts of phosphatic gravel perfectly distinct; the one is a gravel containing, besides the terreous phosphates, existing normally in the urine, a certain quantity of ammonia, that is ammoniacal-phosphatic gravel, called catarrhal gravel by medical writers; the other is a gravel solely constituted by terreous phosphates, that is to say by phosphates of lime and magnesia. This latter gravel is a diatesic gravel, as we are about to show.

Non-ammoniacal phosphatic gravel, is most often, not to say always, a general affection having for cause a lesion of the nervous system which governs the chemical functions accomplished in the rhenal glands during the excretion of the urine. The kidneys, in that variety of gravel, have lost their acidifying properties, to employ the striking expression of Dr Prout.

Phosphatic ammoniacal gravel is admitted by the generality of medical men; the existence of simple phosphatic gravel, that is to say non-ammoniacal, is denied, or at least a doubt is cast on it, especially in France, by the majority of surgeons engaged in the treatment of maladies of the urinary passages. We think, says M. Mialhe, that if those two kinds of gravel are not equally well known to therapeutists, the reason is that they are far from producing the same pathological disorders.

⁽¹⁾ Mialhe. — Rapport général des Eaux minerales, read at the Academy of Medecine on the 16th January 1872.

Phosphatic ammoniacal deposits therefore very frequently give rise to gravel, and even to calculi; which scarcely ever happens with the other deposits. The explanation of that phenomenon is easy; in ammoniacal deposits the ammonia, which is the cause of the precipitation of terreous phosphates, is also the cause of the production of a vesical mucus, sui-generis, very fitted to favour the agglomeration of insoluble phosphatic salts, and to serve as a cement to the calculi. Whilst in non-ammoniacal phosphatic deposits, the bladder does not produce any mucous secretion, the phosphates precipitated in that organ meet with no obstacle to their complete evacuation by the urine, so that persons who are subject to that kind of deposit generally concern themselves little about it.

- §— In that kind of urinary phosphatic deposit, can the alkaline water of Vichy increase the precipitation of terreous salts in the bladder? Unquestionably no! Because that water is supersaturated with carbonic acid, and with an excess of carbonic acid the precipitation of phosphates of lime and magnesia cannot take place.
- §— It is evident that the efficacy of the Vichy waters against phosphatic deposits and calculi must be admitted by physicians as well as by chemists, and that the efficacy of those waters is as incontestable against uric gravel and calculi.

It is by this same chemical action, by the introduc-

tion of a large quantity of bi-carbonate of soda into the system, that the Vichy waters are proper for all calculous affections of the urinary organs. They modify the pathological state of the mucous membrane of the bladder, liquidify the mucus secreted, and in thus acting on the composition of the blood, by preventing the formation of uric acids or neutral phosphates, change the constitution of the urinary principles so that when they arrive in the kidneys and bladder, they no longer contain any insoluble substances of a nature to form precipitates.

§—Thus, practical facts and chemical deductions are in accord in sanctioning what experience and observation had already demonstrated, to destroy the prejudices arising out of an erroneous appreciation of the phenomena.

Patients have nothing to fear from the chimerical dangers exhibited to them; in no case can the Vichy waters aggravate their position; always, on the contrary, they will determine a sure relief if not a complete cure.

SACCHARINE DIABETES

§ — By the name of *Diabete sucré* or *Glycosuria* is designated the principal malady characterized by an excessively abundant excretion of urine more or less charged with saccharine matter.

Those inodorous and discoloured urines, resembling clarified skim-milk, present a very remarkable density, and when they are boiled with a solution of potash, soda, or lime, they take a reddish brown colour, the darker in proportion to the quantity of sugar of starch or glucose they contain.

They are accompanied with a parched mouth, an unquenchable thirst, extraordinary hunger, loss of bodily strength, of sight, of the generative powers, an absence of perspiration, constipation, emaciation, a general wasting away, in fine with all the consecutive disorders of consumption and phthisis.

The starting point of those disorders is sugar in the urine, but what is the cause of this.

§ — About thirty years ago the diabetic affection was looked on as a singular and inexplicable phenomenon, a sort of caprice of nature in a distempered state; rarely observed, and unknown in its causes and its nature, it remained a mystery impenetrable to science, and inaccessible to therapeutics.

To explain the formation and presence of sugar in the urine, all kinds of maladies and hypotheses were suggested: irritation of the bladder, chronic gastritis, special affections of the digestive organs, superoxygenation of the humours, disturbance of the assimilating functions, a particular agent existing only with diabetic patients, etc.

The multiplicity of the remedies opposed to it in vain gave the measure of their impotency.

Yet experience had shown that in certain cases lime water and alkaline drinks had assuaged the thirst and procured some relief:

But it has only been since 1844 that in consequence of the researches into the nature and cure of diabetes, a certain number of patients have been sent to take the waters of Vichy. (1)

« It is principally in consequence of the theoretical « views and recommendations of M. Mialhe, we are « pleased to render him that justice, says D' Durand-« Fardel, that alkalis, and for that reason the ther-« mal treatment of Vichy, have been prescribed for « diabetic patients. (2)

All in fact obtain there, in a short time, a very great relief; if they take the mineral waters in sufficient quantity, the sugar disappears gradually, then completely, from the urine; the thirst is assuaged, the sight recovers, the general strength is restored, the constipation changes to motions, at first bilious, and then regular, calm succeeds to uneasiness, and sleep to wakefulness. After fifteen or twenty days of the treatment the patient may, in most cases, modify the diet to which he has been sujected, may resume, in moderation, the use of bread, potatoes, and feculas without 'eing the sugar reappear in the urine.

Those facts are almost constant; they are borne

⁽¹⁾ Mialhe. — Nouvelle théorie du diabète sucré ou glycosurie. Paper communicated to the Academy of Sciences.

⁽²⁾ Lettres médicales sur Vichy, 1855

witness to by patients and medical men, only they are explained in divers manners; some consider the relief obtained as a result of the tonic action, and of the stimulating properties which almost all mineral waters exercise on the skin, the secretions, and the functions in general; others, while admitting the efficacy of exciting action, find in the chemical composition and alkalinity of the Vichy waters, the real cause of the happy modifications determined in diabetic patients.

In that affection the Vichy waters are therefore accepted by all as a very useful adjuvant, or a specific and sovereign remedy.

§ — To prove clearly the importance and the necessity for the alkaline treatment, it is advisable to exhibit succinctly, the different works by which recent attempts have been made to explain the origin of the sugar in the urine.

It is well known that all the matters contained in the urine, exist already formed in the circulatory torrent, and that having ceased to be utilizable for the animal economy, they pass through the kidneys, like through a filter, and are expelled by the genito-urinary organs.

The existence of sugar in the system in the normal and physiological state, is a recognized fact; that sugar is produced in three ways: by the ingestion of sweetened articles of food, by the transformation of amylaceous aliments, or in fine it is the result of a secretion of the liver.

It has been proved that the amylaceous aliments, before being digested and destroyed in the organism, are transformed into dextrine and glucose under the influence of a special ferment discovered in 1845 by M. Mialhe, the animal diastase existing in the saliva and pancreatic juices. According to M. Mialhe that transformation is effected more by the saliva than by the pancreatic juice; according to MM. Bouchardat and Sandras the pancreatic juice is the principal cause.

M. Claude Bernard has on his side demonstrated by experiments on living animals that the liver always contains a certain quantity of sugar, independently of the kind of diet to which the animal is restricted, and consequently that the liver is an organ which secretes sugar.

Therefore sugar of starch, or glucose, exists normally in the economy.

§ — But how is it that in a healthy state sugar is never met with in the secretions, and that it disappears so rapidly from the blood that a few hours after its entry into the system it leaves no appreciable traces? How is it decomposed and destroyed to serve for the requirements of the economy?

There we are in the domaine of chemistry; all modern writers, Prout, Dumas, Liebig, etc. have divided aliments destined for animal food into, two classes, azotized and hydro-carbons.

The azotized aliments (fibrine, albumen, casein, and gluten), are called plastic aliments because, being

destined for the maintenance and repair of the organs in the economy, they should not disappear by intervisceral combustion; and while combining with oxygen, by becoming more or less oxydized, they only play a small part in the respiration and the production of the animal heat.

The hydro-carbons (starch, sugar, fat and oil) are called respiratory or calorific aliments, because as they are almost entirely burnt away by their union with oxygen, they play a greater part in the phenomena of respiration and calorification.

Now if the glucose derived from the alimentation and the secretion of the liver, and which exists normally in the system, ceases to unite with the oxygen to serve for the respiration and calorification; if, having become a foreign and non-utilizable body, it passes in its natural state into the secretions, the reason is that some powerful and abnormal cause prevents its decomposition: it is then a pathological fact, the consequence of a perturbation of the chemical phenomena accomplished in the organisms, when in a healthy state.

That perturbation M. Mialhe explains by the want of a sufficient alkalinity in the humours of the animal economy, and to explain that diminution of alkalinity he thought formerly that the abuse of acid liquors, an exclusively azotized alimentation, or the suppression of the emonctory perspiration intended to eliminate the acids of the organism, were sufficient reasons; but since, in consequence of researches on the influence

of the nervous system on the secretions, he has been led to consider the diabetic affection in a new light, and to admit that the primary cause of the presence of sugar in the urine does not consist solely in an abnormal chemical composition of the blood, but in an essentially nervous affection, as M. Claude Bernard had for a long time previously taught, only, in the opinion of M. Mialhe, that affection is not limited to the pneumogastric muscles; it is a general neurosis, produced most frequently by a nervous trouble, having generally for cause a very violent grief.

Diabetes is therefore, in the opinion of M. Mialhe, a general neuropathy affecting all the nerves which govern the secretions; a neuropathy having for result, on the one hand to exaggerate the production of sugar in the organism, and on the other to modify the composition of the humours in the animal economy.

The want of a sufficient alkalinity of the humours, is therefore no longer, in the opinion of M. Mialhe, the primary cause of diabetes, but only the consequence of it, and indeed he says, as soon as, from a simple nervous lesion, the sugar arrives unchanged in the urine, the chemical composition of the humours in completely modified, as is proved incontestably by te following experiment, which constitutes the starting point in the discovery of glycogénie.

« M. Magendie announced to the Academy a very important and unexpected physiological discovery recently made by M. Claude Bernard. It results from experiments made by that young savant, that the cons-

titution of the urine may be modified, and sugar be introduced into it, by wounding with a pointed instrument, the superior membrane of the fourth ventricle. »

« The puncture is effected through the lower orifice of the ventricle; and soon after, the urine of the animal (arabbit), which before that operation was turbid, alkaline, without saccharine matter, clear, acid, and holding in solution a large quantity of sugar, becomes similar to that of a diabetic patient. In general not more than an hour and a half or two hours is necessary for that complete change in the character of the urine to be effected. The blood also contains much sugar (1).»

If the objection is made that the presence of saccharine matter in the urine of rabbits subject to a nervous lesion is not due to an insufficient alkalinity in the sanguineous liquid, and that it is only the result of an exaggerated excess of the saccharine secretion of the liver, M. Mialhe replies that such is not the case, as observation proves that rabbits in their normal state may take in their food a proportion of sugar superior to that which is then exceptionally excreted by the liver, without any particle of the saccharine matter arriving in the urine.

The necessity of alkalis for the decomposition of the glucose is besides proved by direct experiments apart from the organism; warmed with soda, potash, or their carbonates, the glucose forms combinations

⁽¹⁾ Magendie, Compte-rendu de l'Académie des sciences 26 mars 1849.

which are called glucosates: ephemeral combinations which are destroyed almost immediately in giving rise to the production of brown or black matters.

M. Mialhe has also shown, contrary to the opinion admitted by all chemists, that glucose has not in itself any affinity for oxygen, and that alone it is incapable of decomposing or reducing certain metallic oxydes: that it possesses no action on bi-oxyde and salts of copper, either cold or hot, unless in contact with free alkalis or carbonates, transforming them into ulmic matters, which alone absorb the oxygen and effect the reduction.

From those incontestable facts he draws the following conclusions:

The glucose must, whether within or without the economy, be subject to the same chemical laws.

It cannot combine with the oxygen until after being decomposed, by the indispensable intervention of free or carbonated alkalis, into new elements, such as ulmic, formic, glycic or melassic acid, which form new salts with the bases;

The combination of those productions with the oxygen is a real combustion (like that of citrates, tartrates, etc.) which produces always identical results, namely water, carbonic acid and ulmic matters;

In the organism it is the sanguineous liquid which furnishes the elements of decomposition: alkaline carbonates and oxygen; if those elements are in sufficient quantity the glucose is destroyed completely and

leaves no traces; if they are not in sufficient quantity, the non-assimilated, or rather non-destroyed, glucose, is repected by the functions of secretion.

M. Mialhe observes that, apart from the special action of the alkaline carbonates, everything that will favour or impede the general phenomena of intervisceral combustion, will exercise the same influence on the destruction of glucose. He is thus in perfect accord with M. Alvaro Reynoso, who has proved that when any cause occurs to disturb the respiration and impede the hematosis, there is incomplete combustion, and consequently the passing of more or less sugar into the urine.

Let us suppose, says M. Mialhe, that the proportion of those elements, glucose, alkalis, and oxygen, is changed, without their being placed in a suitable relation, the chemical phenomena of the organism will be immediately modified.

If the glucose alone is increased, the alkalis and oxygen will no longer be able to effect entirely the decomposition and oxydization.

If to an addition of glucose is added an addition of alkali, then the oxygen will be insufficient for the combustion of the saccharine matters.

Lastly. if the quantity of glucose remains the same, and the alkali or oxygen should be diminished, the decomposition on the one hand, and the combustion on the other, will not take place, and the glucose will appear in the urine.

In that manner M. Mialhe comprehends the neces-

sity for the presence of the alkalis and oxygen for the combustion of the glucose, and such is his conclusion. It is solely by the intervention of the alkalis of the blood that the glucose and its congeners are decomposed, oxydized and burnt, and become real calorific elements, an opinion which has received the sanction of two of the greatest modern scientific authorities, Lehmann and Liebig (1).

* § — Saccharine diabetes being the result of a general neuropathy, having for effect to exaggerate the production of sugar in the organism, and to modify the chemical composition of the humours of the economy, it is necessary, by an appropriate treatment, to endeavour to re-establish the natural order of the assimilating functions, by administering the different neuropathic agents which the science of therapeutics has at its command: and to remedy the vitiation of the humours should be prescribed the use of lime water, carbonates, ammoniac, milk of magnesia, bi-carbonate of soda, or Vichy water. What is required is to introduce a sufficient quantity of alkali into the blood. If Vichy water and bi-carbonate of soda have been spocially recommended, it is because they have been employed with greater advantage, and are taken by patients with less repulsion than most of the other agents of an alkaline medication.

⁽¹⁾ Lehmann, Précis de chimie physiologique animale, p. 318.

— Liebig, Nouvelles recherches sur la chimie, p. 171. — See also: W. Pavy, The influence of an acid in producing saccharine urine (Proceedings of the Royal Society, vol. XI. p. 336, 1861).

To re-establish the respiration use should be made of alkaline or vapour baths, flannel, frictions, sudorifics, in a word anything that can favour the cutaneous secretion and render it more abundant; at the same time, by walking and by muscular exercise, the circulation and perspiration should be promoted, to produce more complete phenomena of intra-visceral combustion.

To understand the value of these last indications practicians cannot be too greatly recommended to penetrate themselves well with the importance of the precepts laid down in the remarkable work of Professor Bouchardat entitled: De l'entraînement ou de l'exercice forcé appliqué au traitement de la glycosurie (Training or severe exercise in the treatment of glucosuria).

With respect to the alimentation, which may exercise a great influence, the fact must be observed that an animal diet, employed as a curative of the diabetic affection, only constitutes a palliative treatment, and that it is only by the use of sudorifics and alkaline preparations, that we may hope to overcome the primary cause of the disease; food containing a large proportion of fæculæ should not be entirely proscribed, but only reduced in quantity, for evidently it is not the saccharification of the fæculæ that constitutes the malady, but the tendency the sugar has to pass into the urine without being decomposed, and which tendency may exist even although, fæculæ may have been introduced into the economy.

§ — Thus, whether the theory just explained is adopted, or whether, to it is preferred the ideas of a certain number of medical practitioners who only admit as the result of the thermal treatment the general excitement and the particular tonic state developed in the economy of diabetic patients, the result is nevertheless acquired, that of all mineral waters, those of Vichy, being the most charged in general with bi-carbonated principles, constitute, if not the only and real treatment of diabetes, at least the most favourable medication, that which has hitherto presented the most satisfactory results. They possess tonic virtues quite as powerful as sea bathing, and other mineral waters, and in addition they possess the advantage of adding to that general exciting action, the specific properties which characterize them. By the alkalis which they introduce into the sanguineous liquid, they reconstitute the chemical conditions necessary to life, and to the dissolution and secretion of bile; they give a limpidity to the humours, which, under the influence of the acids had assumed a milky appearance, and as a consequence restore to the sight its force and clearness; they cause the destruction of the glucose, and thus re-establish the health, as a natural result of a normal state of the organism.

Some diabetic patients have now for a long time past returned from Vichy relieved in a extraordinary degree; others, in whom the affection was only commencing, have been cured, as if by enchantment, in a very short space of time.

A stay and treatment of some weeks at Vichy, are generally sufficient to paralyze and put an end to a malady formerly considered as incurable and always mortal; and even although the primary cause may not be completely destroyed, and there is a necessity to continue, far from the springs, the use of the Vichy water, the fact must be admitted that the cessation of morbid accidents, the re-establishment of the strength and physical well being, obtained by the aid of a remedy which is neither disagreable nor irksome, must be considered as an incontestable success and a real blessing.

XV

THE MINERAL WATERS TRANSPORTED

The medical waters of Vichy constitute an effective medicament, which renders great services to therapeutics.

Notiwthstanding the extension which the use of the bottled mineral waters has acquired during the last few years, their use is still infinitely too restricted, considering the services they may render, for with the exception of the Vichy waters, certain sulphurous springs, and some purgative waters, for which a preference is often given, although wrongly, to artificial

waters, how many medical men never employ systematically, or otherwise, in their practice, any mineral waters!

The fact should not however be forgotten, that mineral waters transported, are an inimitable medicament.

There are a very great number of circumstances in which it is necessary to have recourse to the transported mineral waters, and to obtain from them whatever they have preserved of the properties of mineral waters taken at the springs. Distance, business, and the expense, sometimes prevent persons from visiting the thermal springs recommended. If that is true for the residents of a country in which the watering places are situated, how much more must it apply to the inhabitants of distant countries, and to confine ourselves to the field of application of the Vichy waters, to the inhabitants of Algeria and the French and English colonies, who would find in the use of those waters a most appropriate remedy for the disorders which follow the serious and numerous endemical maladies which reign in the countries they inhabit.

There is observed in hot countries, and in a more intense degree the nearer we approach the tropics, a particular pathological state resulting from varied morbid determinations, such as hepatic complaints, enteritis or dysentery, and intermittent fevers, to which may be justly applied the denomination of the cachexia of warm countries, and which obtain at

Vichy an extremely beneficial treatment. Algeria, the west coast of Africa, British India, and the French colonies in the West Indies, have during the last twenty years contributed a numerous population to Vichy, and observations thus obtained have shown the singularly powerful influence of the thermal treatment in all cases in which irremediable organic diseases do not form an insurmountable obstacle to the cure.

The bottled Vichy waters, with baths of the Vichy salts, have a similar action and form one of the treatments the best adapted to the pathological conditions we have just described.

At Vichy, says D^r Durand-Fardel, the bottling and despatch of the waters is performed with the greatest care by the chartered Company, and besides presents the most serious of guarantees; it takes place under the special superintendence of a Government Commissioner in conformity with the conditions of the treaty of concession. Moreover, by a precaution which we should be glad to see adopted elsewhere, to give to the patient and the physician additionnal security, besides the system of corking by machinery, each bottle is secured by a tin capsule bearing the date of the year of bottling (1).

⁽¹⁾ The consumption of the bottled Vichy waters has undergone an increase in a proportion still greater than that above mentioned in the visitors to the thermal establishment. From 350,000 bottles in 1853, the exportation amounted in 1865 to 1,983,000 bottles. This introduction into therapeutics, in such proportions, of an agent which a few years

Many physicians, writes D' Durand-Fardel, think they may prescribe indifferently the Vichy water or common bi-carbonate of soda, in cases of uric gravel; that is, in our opinion, an error. Bi-carbonate of soda has on the essential symptoms of the malady — the appearance of red sand in the urine — a direct and marked influence. Its effects are however confined to the symptoms of the disorder only. If we wish to arrive at the malady itself, something more must be done. The Vichy thermal treatment presents one of the most efficacious remedies, and the bottled Vichy water approaches much nearer to it than a mere solution of bicarbonate of soda.

back was only employed in a very restricted manner, is certainly a very remarkable fact. The question is of interest from an economic as well as from a medical point of view, and deserves attention.

The number of bottles of Vichy water sent out since the concession of the springs to the Company by the State, is as follows:

YEARS	BOTTLES	YEARS	BOTTLES
1853	461,894	1864	. 1,678,400
1854	481,312	1865	. 1,932,672
1855	563,742	1866	. 2,064,919
1856	662,769	1867	. 2,011,808
1857	699,662	1868	. 2,416,396
1858	754,210	1869	. 2,456,357
1859	946,346	1870	. 2,159,495
1860	1,087,009	1871	. 2,252,234
1861	1,193,073	1872	. 2,767,701
1 832	1,311,785	1873	. 2,901,043
. 1863	1,502,940	10 -0 01	

When the Vichy waters are prescribed to a patient, nothing more has been done than if he had been ordered a narcotic, anti-spasmodic, or alterative treatment. There still remains to fix the choice of the spring or remedy, dose, mode of administration, etc.

But when the bottled waters are to be used the principles which govern their administration are quite different.

The water of the *Hauterive* spring appears to us to be the most fitted to replace, at a distance, the Vichy water which cannot be taken on the spot; its remarkable sapidity and the ease with which it is supported by the stomach, recommend it not less than the excellent therapeutic results it furnishes.

Sometimes, however, the Hauterive water is found to be a little too stimulating, it should then be replaced by the Grande-Grille. The Celestins water, and the Hauterive are those from which the best results may be expected.

The bottled Vichy waters are generally ordered to be taken at meals. The gastric secretions necessary to digestion, are aided by the presence of the alkaline waters and the alsorbtion of the latter is effected with the more activity. The mixture with the wine, not-withstanding the decomposition it produces, and which changes the colour of the wine, does not impair the properties of either of the liquids.

XVI

The derivatives of the mineral waters, as the productions extracted from them for medical purposes are called, may furnish useful preparations, which, from their origin, preserve properties distinct from purely artificial preparations. Their utility, says Dr Durand-Fardel, must be admitted, and if any attempts of that kind deserve to be encouraged, it is, we must say, those to which the Vichy waters have given rise, and in which a remarkable intelligence and perseverance has been displayed.

The first essays attempted with the Vichy waters were with the object of extracting the salts.

1° First by letting the mineral water fall on plates of enamelled iron in contact with steam. 2° By evaporating the water in boilers at a pressure of several atmospheres. 3° By evaporating it over open fires in large sheet-iron pans.

Numerous and successive improvements, to which several eminent chemists, and among others MM. Pelouze, Fremy and Lefort contributed, have led to the present mode of extraction.

But a description must first be given of the laboratories in which the manipulation of the salts is carried on.

The process is divided into two distinct parts:

1° The extraction and evaporation of the salts. That

operation is conducted on the ground floor and in cellars, and comprises: the evaporation of the water, the drying of the salts, the saturation by carbonic acid, and the final preparation,

2° The manufacture of lozenges.

We will first describe the extraction of the salts.

That process is effected in two different ways, according whether the salts are intended for drink or for baths.

Salts for drink.

These salts are prepared in the following manner. The mineral water is brought from the springs by means of a pump into pans of iron plates heated to a variable temperature, and is thus maintained until the bicarbonates of lime and magnesia it contains are transformed into insoluble carbonates, which are precipitated; the water is then placed in a large iron pan and is boiled over an open fire until evaporated to 24 degrees of the aerometre.

That done, the water is conveyed to stone crystalizing basins where, as it cools, it deposits crystals on the sides. Those crystals, which are chiefly formed of the neutral carbonate of soda, are removed and subjected to the action of the carbonic acid gas which escapes from the springs; that acid restores to the carbonate the carbonic acid it had lost by the action of

the heat, and again forms a saline compound similar to that which existed in the mineral water. The crystals being then dried at a low temperature and pulverized, serve for making artificial Vichy water, and the Vichy lozenges.

Salts for baths

To obtain the salts for baths the mineral water (to which is added the mother water derived from the operation just referred to) is evaporated at 34 to 36 degrees of the aerometre. The crystals are removed by degrees as they are formed, and the evaporation is continued until no water remains. The residue and the crystals first obtained are then mixed; the produce is placed in chambers of carbonic acid gas in which the carbonate of soda returns to the state of bi-carbonate; it is dried and roughly pulverized, and then made into packets of the proper size for baths.

Lozenges

The Vichy lozenges are well known although their use only dates from 1822. Darcet having remarked that the bicarbonate of soda was the most active substance in the Vichy waters, had the idea of making it into lozenges to which he gave the name of Pastilles of Vichy. The lozenges now made by the thermal Es-

tablishment of Vichy are composed of the salis extracted from the Vichy waters according to the reciper of Darcet, with the exception of those salts being substituted for the bicarbonate of soda.

However, the State, not wishing that the thermal Establishment of Vichy, its property, should offer to the public an article which was not genuine, decided by a decree dated the 2nd March 1857, that all the products derived from the springs of the thermal Establishment should be first analyzed, and their manufacture inspected, and when offered for sale be accompanied with a certificate of their origin, and marked with the Government stamp by agents specially appointed for that purpose.

That guarantee, now acquired to the public, has given a very great development to those new productions, salts for drink, salts for baths, and lozenges.

Now what is the therapeutic value to be attributed to that medicament?

Have the salts extracted from the Vichy waters and employed as a drink in baths, or as lozenges, an efficacy superior to bi-carbonate of soda? I do not hesitate, says M. Durand-Fardel, to reply in the affirmative. While possessing all the properties of bicarbonate of soda, they derive from the salts which they retain after the evaporation of the waters, more tonic qualities, and perhaps something more difficult to determine, but which will no doubt be proved by experience.

DESCRIPTION

OF THE THERMAL ESTABLISHMENT

The thermal Establishment of Vichy belongs to the French State, which conceded the working of it to the chartered company of the thermal Establishment of Vichy (limited liability) of which the offices are at Paris, 22, Boulevart Montmartre.

The Thermal Establishment comprises:

The Great Establishment containing the first class baths and douches, a piscine, the Direction, and offices for the inscription of bathers.

The New Establishment containing the second and third class baths and douches.

The Hospital Establishment on the place Rosalie, containing first and second class baths and douches, sulphur baths, a piscine, etc.

The New Casino with its theatre, ball, reading, and card rooms.

The garden and music pavilion.

The Café of the Restauration.

The Assembly Rooms and Celestins Park.

The old Park.

The springs of the State.

Also different dependencies and buildings among which are the reservoirs, fountains for the bath service, laboratories for the evaporation of the mineral

waters, the manufacture of the salts and pastilles, supply cisterns, laundry, linen rooms, drying house, pumprooms, boilers, engine house, warehouses and work shops for packing and for various mechanical or hydraulic works.

* *

Independently of the machinery for raising soft and mineral waters, immense cisterns and reservoirs to assure the supply, and the extensive organization of subteranean acqueducts and metal pipes, the bath service comprises for the service of baths and douches, the following apparatus:

96 rooms for 1st class baths;

198 d° d° 2nd class d°

24 d° d° 3rd class d°

Two piscines, the one to accomodate 20 persons, the other 14.

Service for sending baths to the residence of patients, and for conveying patients to and from the hotels to the Establishment.

10	apparatus	s for	percussion	douches,	lst class.
11	d°		d° .		2 nd class.
2	d^{o}		d°		3rd class.
7	$\mathrm{d}^{\mathbf{o}}$	for	ascending	douches,	lst class.
8	d^{o} .		d°		2 nd class.
2	d°		d°		3 rd class.
3	ď°	for	douches,	in baths	lst class.
5	d°	1	d°		2 nd class.
156	d°	for v	aginal douch	ies.	
ĵ	d°		hes or vapou		
		4			

2 Rooms for baths, douches, or the inhalation of carbonic acid.

1 Room for the inhalation of oxygen gas.

of pulverized mineral waters.

10 Hip baths.

10 Foot baths.

The series of baths are opened or suppressed according to the requirements of the service.

The douches may be had at any hour from the opening to the closing of the Establishment.

* *

List of the different kinds of baths or douches supplied at the thermal Establishment of Vichy.

Mineral baths in cabinets or in the piscines.

Mineral baths with douches.

Sulphurous baths (Barèges):

Aromatic baths.

Soft water baths.

Mineral or soft water baths at home.

Douches in baths.

Percussion, varied jet, Scotch, cold douches, etc.

Ascending douches.

Vaginal douches.

Vapour baths or douches.

Baths or douches of carbonic acid gas.

Inhalation of carbonic acid gas.

Inhalation of oxygen gas.

Inhalation of the mineral waters of Vichy and other mineral waters, Eaux-Bonnes, pulverized etc.

Hip baths.

Foot baths.

Shampooing and frictions.

Prices of the baths and douches linen included:

1st class, 3 francs.

2nd class, 2 francs.

3rd class, 60 centimes.

No charge is made for the mineral water drunk on the spot: carried away it is changed 30 centimes per litre.

It is sold at 60 centimes per bottle, at Vichy, packed for sending away.

* *

By a special clause in the condition of the Company's concession, the thermal Establishment is bound to supply water for the baths of the military thermal hospital. For that purpose 24 cubic metres of mineral water are poured daily into the cisterns of the latter establishment for the bath service of the 120 officers and 60 sub-officers or solders who are patients there.

The Establishment is also bound to provide gratuitously for the thermal treatment of the sick belonging to the following classes: Ecclesiastics, Christian brothers, school masters and mistresses authorized by Government, the inhabitants of Vichy, paupers in the hospitals or outside; those patients must be provided with cards delivered by the Medical Inspector and the Government Commissioner.

The laboratories for the evaporation of the waters and the manufacture of the salts and lozenges, consist of: 1° For the evaporation of the salts:

12 large flat boilers evaporating 18,000 litres of water a day, and producing from 200 to 220 pounds of salts in the twenty four hours.

10 crystalizing pans.

2 rooms for the saturation with carbonic acid, and a vast stove for drying the salts.

2° For the manufacture of the lozenges:

Several machines for cutting the lozenges:

A mill for pulverizing the salts and sugar.

Machines for sifting the powder, and for kneading the paste.

Sugar cutters, etc., etc.

The whole worked by a steam engine and producing 300 pounds of lozenges a day.

The medical surveillance of the Establishment is exercised by a Doctor-Inspector, and an assistant Doctor-Inspector.

A Government Commissioner watches over the execution of the conditions of the concession; he exercises an inspection over the manufacture of the natural Salts of the Establishment and delivers, according to the administrative prescriptions, the guarantee of the State in proportion to the articles manufactured and duly verified.

One of the most important Establishments of the Company is the new warehouses for sending out the bottled waters. In that building, which covers a surface of 4,000 square metres, is carried on all the operations

through which the bottles pass from their arrival from the makers, to their delivery to the trade filled with Vichy water, that is to say, the sorting for the elimination of defective bottles, rinsing, filling, corking, capsuling, labelling, and packing.

The warehouses are also a depôt for all kinds of French and foreign mineral waters.

The principal works are executed there by steam machinery.

They are connected by a branch line with the railway station, and receive and deliver annually nearly 4,000,000 bottles, independently of the other merchandise received or sent off by the Company.

Comparison of the number of bottles of Vichy water sent off annually betwen 1850 and 1873, and of the Strangers who visited Vichy during that period.

YEARS	VISITORS at VICHY	BOTTLES SENT OFF	YEARS	VISITORS at VICHY	BOTTLES SENT OFF
1850	6.709	347.348	1862	17.401	1.311.785
1851	6.954	370.542	1863	19.625	1.502.940
1852	6.823	407.744	1864	20.673	1.678.400
1853	6.653	461.894	1865	19.092	1.933.672
1854	7.802	481.312	1866	21.357	2.064.919
1855	8.882	563.742	1867	20.599	2.011.808
1856	9.626	662.769	1868	22.939	2.416.396
1857	9.922	699.662	1869	23.262	2.456.357
1858	11.918	754.210	1870	17.035	2.159.495
1859	12.909	946.346	1871	17.209	2.252.234
1860	12.690	1.037.009	1872	25.524	2.767,701
1861	16.044	1.193.073	1873	25.433	2.901.043

MEDICAL CORPS

The consulting physicians at Vichy are at present twenty-one in number. Their addresses are the following:

MM.

DUBOIS AMABLE (**), Médecin-Inspecteur. rue Lucas, opposite the Grande-Grille.

WILLEMIN (O. *), Inspecteur-Adjoint, boulevart National, Chalet almost opposite the rue Prunelle.

DURAND-FARDEL (*), Médecin-Inspecteur de la source d'Hauterive, rue du Parc.

BARUDEL (O.*), Médecin principal de 1^{re} classe, Médecin en chef de l'Hôpital militaire.

BINTOT (O. *), Médecin principal de 2º classe à l'Hôpital militaire.

CAROLUS DE LA SALZÈDE, villa Maria.

CHAMPAGNAT, boulevart de l'Hôtel-de-Ville.

CHARNAUX, rue Lucas, near the 2nd class thermal Establishment.

CHOPART, Médecin-Adjoint de l'Hôpital eivil, 40, rue de Nîmes.

COLLONGUES, rue Alquié, Maisons Anglaises.

CORNIL, maison Maymat, rue Lucas.

CORNILLON, avenue de la Gare.

DAUMAS Casimir (*), rue Prunelle, opposite the Park spring.

DURAND (de Lunel) (O ¾), Médecin principal d'armée retraité rue Alquié, n° 7.

FOURNIER, rue Lucas.

GAUDIN (*), Médecin de marine retraité, rue de Nîmes.

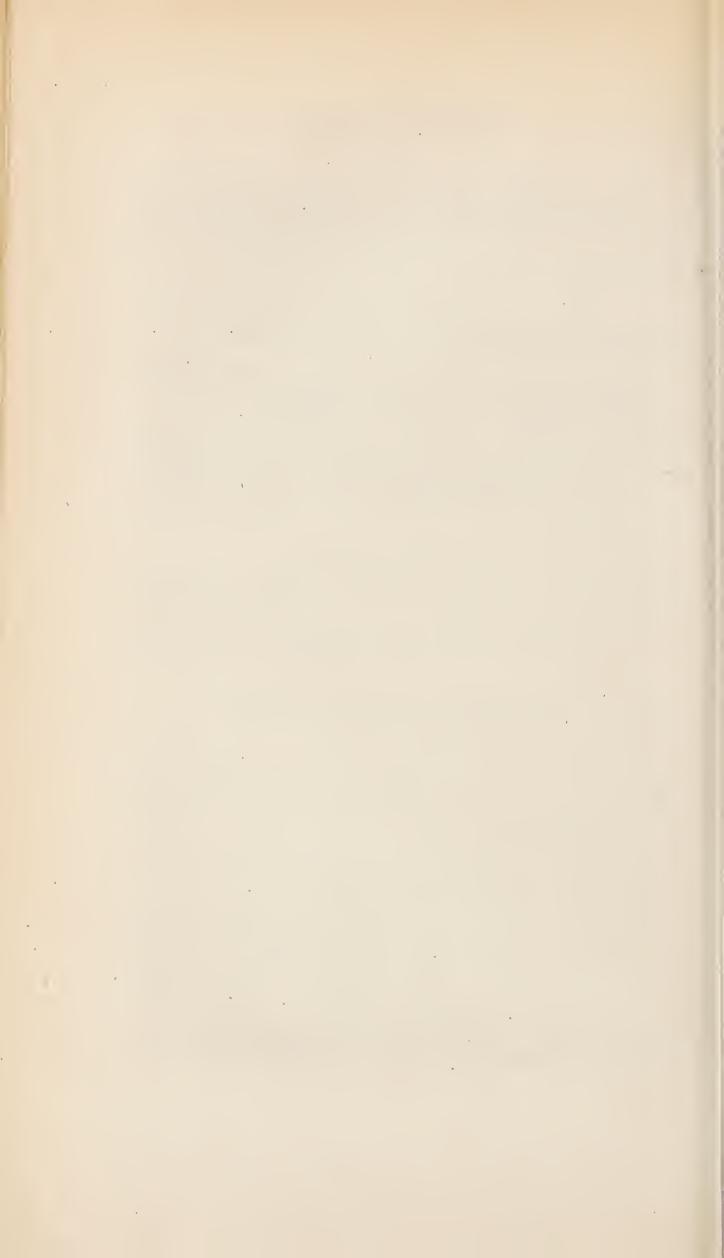
GRELLETY, rue Prunelle, châlet Paturle

JARDET, Médecin du chemin de fer, Directeur de l'Etablissement hydrothérapique, rue de Ballore.

NICOLAS, Médecin en chef de l'Hôpital civil, rue de Nîmes.
PUPIER, villa et rue Strauss.

SÉNAC, rue du Parc, opposite the Music Pavilion.

SOULIGOUX (*), boulevard National, villa Thérapia.



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PRINCIPAL WORKS ON VICHY

FROM A MEDICAL POINT OF VIEW.

- Dr C. Petit: Du Mode d'action des Eaux minérales de Vichy.
- D' Willemin: 1° De l'Emploi des Eaux de Vichy dans les maladies chroniques de l'utérus. 2° Des Coliques hépathiques et de leur traitement par les Eaux de Vichy.
- D' Dubois (AMABLE): Manuel du Malade à Vichy.
- Dr Durand-Fardel: 1° Traité sur les Eaux de Vichy, considérées sous les rapports chimiques et thérapeutiques. 2° Mémoire sur la médication de Vichy dans le traitement des maladies de matrice. 3° Lettres médicales sur Vichy. 4° Le Diabète. 5° Traitement de la Gravelle. 6° Dictionnaire des Eaux minérales. 7° Traité clinique et thérapeutique du Diabète. 8° Résumé du même traité. 9° Traité pratique des maladies chroniques. 10° Traité des maladies des vieillards. 11° Les Eaux minérales et les Maladies chroniques, leçons professées à l'Ecole pratique.
- D' Durand de Lunel: 1° Des Incidents du traitement hydrominéral de Vichy. — 2° Traité dogmatique et pratique des fièvres intermittentes, suivi d'une notice sur le Mode d'action des Eaux de Vichy dans les affections consécutives à ces maladies. — 3° Des indications et des contre-indications des Eaux de Vichy. — 4° Vichy et Vals comparés.
- D' Barbier: 1° Nouvelle théorie du Diabète. 2° Médication hydro-carbonique. 3° L'Orient au point de vue médical. 4° La vie ecclésiastique et les maisons religieuses (Maladies traitées par les Eaux de Vichy).
- D' Marchal (de Calvi): Recherches sur les accidents diabétiques.
- D' Nicolas (Victor): 1º Des maladies du cœur. 2º Utilité des Eaux minérales de Vichy.
- D' Mialie: 1° Chimie appliquée à la physiologie et à la thérapeutique. 2° Du rôle chimique de l'acide carbonique dans l'économie animale. 3° De la destruction des acides organiques dans l'économie animale, envisagée au point de vue du régime à suivre à Vichy; 4° De l'action des alcalins dans le traitement des calculs biliaires et vésicaux.

- Dr Barthez: Guide des malades aux Eaux de Vichy.
- D' Constantin James: Guide aux Eaux minérales.
- Dr Chopard: Du Foie et du Diabète, traitement par les Eaux de Vichy.
- D' R. Leroy-d'Etiolles fils: Traité pratique de la gravelle et des calculs urinaires, traitement par les Eaux de Vichy.
- D' Casimir Daumas: 1º Les Eaux minérales de Vichy. 2º Lettre critique sur l'action dissolvante et fluidifiante des Eaux de Vichy. 3º Les Sources de Vichy.
- Dr Carnet: 1º Maux d'estomac, Régime, Hygiène et Traitement.
 2º Une Saison à Vichy, conseils pour bien prendre les Eaux.
- D' Lavigerie: 1° Guide médical aux Eaux minérales. 2° Guia Espanol.
- Dr A. Favrot: Des Maladies des Femmes.
- Dr Collongues: Le Livre des malades à Vichy. Observations climatologiques, etc.
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